Release Note

Software Version 2.7.5

For AT-8800, Rapier i, AT-8700XL, AT-8600, AT-9900, AT-8900 and AT-9800 Series Switches and AR400 and AR700 Series Routers

Introduction

Allied Telesyn announces the release of Software Version 2.7.5 on the products shown in Table 1. This Release Note describes all new features in Software Version 2.7.5. The product series that each feature and enhancement applies to are shown in "Overview of New Features" on page 4.

Table 1: Products supported by Software Version 2.7.5

Product series	Models
AT-9900	AT-9924T, AT-9924SP, AT-9924T/4SP
AT-8900	AT-8948
AT-9800	AT-9812T, AT-9816GB
Rapier i	Rapier 24i, Rapier 48i, Rapier 16fi
AT-8800	AT-8824, AT-8848
AT-8700XL	AT-8724XL, AT-8748XL
AT-8600	AT-8624T/2M, AT-8624PoE
AR700	AR725, AR745, AR750S
AR400	AR440S, AR441S, AR450S

This Release Note should be read in conjunction with the Installation and Safety Guide or Quick Install Guide, Hardware Reference, and Software Reference for your switch or router. These documents can be found on the Documentation and Tools CD-ROM packaged with your switch or router, or:

www.alliedtelesyn.com/support/software

This Release Note has the following sections:

1. **Upgrading to Software Version 2.7.5**

   This section lists the file names that may be downloaded from the web site.

2. **Description of New Features in Software Version 2.7.5**

   This section lists the features that are new for Software Version 2.7.5 and describes how to configure them.

3. **WAN Load Balancing**

   This section contains a copy of the complete WAN Load Balancing chapter. WAN load balancing is newly supported on AR400 series routers, and the balancing methods have been substantially extended.

4. **Filtering IP Routes**

   This section contains a copy of the new Filtering IP Routes chapter. This chapter collects all existing information about filtering IP routes together into one place. It describes when and how to filter routes, and how the different routing protocols work together.

Caution: Information in this document is subject to change without notice and does not represent a commitment on the part of Allied Telesyn Inc. While every effort has been made to ensure that the information contained within this document and the features and changes described are accurate, Allied Telesyn Inc. can not accept any type of liability for errors in, or omissions arising from, the use of this information.

Upgrading to Software Version 2.7.5

Software Version 2.7.5 is available as a flash release that can be downloaded directly from the Software/Documentation area of the Allied Telesyn website:

www.alliedtelesyn.com/support/software

Software versions must be licenced and require a password to activate. If you upgrade to Software Version 2.7.5 from any 2.7.x version, your existing licence is valid for 2.7.5. Otherwise, to obtain a licence and password, contact your authorised Allied Telesyn distributor or reseller.

Table 2: File names for Software Version 2.7.5

Product name	Release file	GUI resource file	CLI help file
AT-9924T	89-275.rez	d9924e24.rsc	99-275a.hlp
AT-9924SP	89-275.rez	d9924e24.rsc	99-275a.hlp
AT-9924T/4SP	89-275.rez	d9924e24.rsc	99-275a.hlp
AT-8948	89-275.rez	—	89-275a.hlp
AT-9812T	sb-275.rez	d9812e24.rsc	98-275a.hlp
AT-9816GB	sb-275.rez	d9816e24.rsc	98-275a.hlp
Rapier 24i	86s-275.rez	dr24ie24.rsc	rp-275a.hlp
Rapier 48i	86s-275.rez	dr48ie24.rsc	rp-275a.hlp
Rapier16fi	86s-275.rez	dr16ie24.rsc	rp-275a.hlp
AT-8824	86s-275.rez	d8824e24.rsc	88-275a.hlp
AT-8848	86s-275.rez	d8848e24.rsc	88-275a.hlp
AT-8724XL	87-275.rez	d8724e24.rsc	87-275a.hlp
AT-8748XL	87-275.rez	d8748e24.rsc	87-275a.hlp
AT-8624PoE	sr-275.rez	—	86-275a.hlp
AT-8624T/2M	sr-275.rez	dsr24e24.rsc	86-275a.hlp
AR750S	55-275.rez	d750se24.rsc	700-275a.hlp
AR725	52-275.rez	d_725e24.rsc	700-275a.hlp
AR745	52-275.rez	d_745e24.rsc	700-275a.hlp
AR440S	54-275.rez	d440se24.rsc	400-275a.hlp
AR441S	54-275.rez	d441se24.rsc	400-275a.hlp
AR450S	54-275.rez	d450se24.rsc	400-275a.hlp

Overview of New Features

This section lists the new features and enhancements by product series. For supported models, see Table 1 on page 2.

Table 3: New features and enhancements in Software Version 2.7.5

	AR400	AR7x5	AR750S	Rapier	AT-8800	AT-8700XL	AT-8600	AT-9800	AT-8900	AT-9900
MSS Clamping	✓	✓	✓	✓	✓			✓	✓	✓
Reflecting TOS onto L2TP-tunnelled Packets	✓	✓	✓	✓	✓			✓	✓	✓
Switch Ports: **Fixed Speed and Autonegotiated Duplex Mode**	✓		✓	✓	✓	✓	✓	✓	✓	✓
Switch Ports: **Fixed 1000Mbps Full Duplex Mode**				✓[a]		✓[a]		✓[a]	✓[a]	✓
Disabling IP ARP Cache Refreshing	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
DHCP Option 82 Relay	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
IGMP: **Fast Leave**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
IGMP: **Filtering and Throttling**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
OSPF Network Types	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
BGP: **Changes to Algorithm for Determining the Best Route**	✓	✓	✓	✓	✓			✓	✓	✓
BGP: **Automatic Summarising: Advertising as Few Routes as Possible**	✓	✓	✓	✓	✓			✓	✓	✓
BGP: **Importing and Advertising the Default Route**	✓	✓	✓	✓	✓			✓	✓	✓
Classifying According to the Layer 5 Byte									✓	✓
Firewall: **Increased Number of Firewall Policy Rules**	✓	✓	✓	✓	✓			✓	✓	
Firewall: **SIP Application Layer Gateway Diagnostic Tools**	✓	✓	✓	✓	✓			✓	✓	
Firewall: **UDP Port Timeout**	✓	✓	✓	✓	✓			✓	✓	
Support for **WAN Load Balancing**	✓		✓[a]							
New Balancing Methods for **WAN Load Balancing**	✓		✓							
VRRP Preemption Delay	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

a. Also supported by earlier releases on some or all models in this series

MSS Clamping

Maximum Segment Size (MSS) clamping functionality has been introduced to Point-to-Point Protocol (PPP) to allow the following:

- User configuration of the MSS clamping value via the command line interface.
- A clamping range of 40 - 200 bytes.

Previously, MSS clamping occurred at a fixed value of 120 bytes.

Overview

MSS clamping reserves a set amount of space within a TCP packet for the header, which in turn limits the amount of space that may be consumed by the data (payload). Setting the header space value to an appropriate level prevents packet fragmentation from occurring.

Maximum Transmission Unit and Maximum Segment Size

The Maximum Transmission Unit (MTU) is the maximum number of bytes per packet that may be transmitted by the network interface. If a single packet exceeds the MTU, it is divided into smaller packets before being transmitted.

For a TCP packet, the MTU can be illustrated by the following equation:

```
MTU = Header Size + Maximum Segment Size
```

where:

- Header Size is the size of the packet header
- Maximum Segment Size is the largest amount of TCP data, in bytes, that the router or switch can transmit or receive in one single data packet.

MTU is set with the **set interface mtu** command. For more information, see the Interfaces chapter of the Software Reference.

Data Transmission and MSS clamping

As packets are sent across various protocols, each protocol adds its own header and encapsulates the information. This can increase the size of the packet being transmitted, potentially exceeding the MTU of devices on the TCP/IP link.

When the packet exceeds the defined MTU for an interface, fragmentation occurs. Packet fragmentation can be costly for the following reasons:

- decreased throughput, the amount of data transferred or processed in a specified amount of time
- networks that are explicitly set to drop fragmented packets suffer communication loss.

Each TCP device uses its MSS value to communicate the highest allowable amount of data it can receive. Although devices in a TCP/IP connection calculate the amount of data to send in a packet based on variables, such as the current window size and various algorithms, the amount of actual data can never exceed the MSS of the device the packet is being sent to.

Setting the MSS clamping value at an appropriate limit prevents fragmentation by reserving a set amount of space within a TCP packet for the header, so that the packet nver needs to be fragmented at any point in its journey. Allowing header space, in turn, limits the amount of space that may be consumed by the data payload.

Example

If the MTU of a PPP interface is 1000 bytes, and you wish to limit the MSS to 850 bytes, use the command:

```
set ppp=0 mssheader=150
```

By setting the **mssheader** parameter to 150 bytes, this amount of space is reserved for the header. If the MTU is 1000, then this leaves 850 bytes of available space in the packet for data.

Command changes

The following table summarises the modified commands (see **Command Reference Updates**).

Command	Change
create ppp	New **mssheader** parameter
set ppp	New **mssheader** parameter
create ppp template	New **mssheader** parameter
set ppp template	New **mssheader** parameter
show ppp template	New **Maximum Segment Size** field
show ppp pppoe	New **Clamped MSS Header Size (bytes)** field

Command Reference Updates

This section describes the changed portions of modified commands and output screens. For modified commands and output, new parameters and fields are shown in bold.

create ppp

Syntax

```
CREate PPP=ppp-interface OVER=physical-interface
   [AUTHENTICATION={CHAP|EITHER|PAP|NONE}]
   [AUTHMODE={IN|OUT|INOUT}] [BAP={ON|OFF}]
   [BAPMODE={CALL|CALLBACK}] [CBDELAY=1..100]
   [CBMODE={ACCEPT|OFF|REQUEST}] [CBNUMBER=e164number]
   [CBOPERATION={E164NUMBER|USERAUTH}]
   [COMPALGORITHM={PREDICTOR|STACLZS}]
   [COMPRESSION={ON|OFF|LINK}]
   [CONFIGURE={value|CONTINUOUS}] [DEBUGMAXBYTES=16..256]
   [DESCRIPTION=description] [DOWNRATE=0..100]
   [DOWNTIME=time] [ECHO={ON|OFF|period}]
   [ENCRYPTION={ON|OFF}] [FRAGMENT={ON|OFF}]
   [FRAGOVERHEAD=0..100] [IDLE={ON|OFF|time}]
   [INDATALIMIT={NONE|1..65535}] [IPPOOL={pool-name|NONE}]
   [IPREQUEST={ON|OFF}] [LQR={ON|OFF|period}]
   [MAGIC={ON|OFF}] [MODEM={ON|OFF}]
   [MRU={ON|OFF|256..1656}] [MSSheader=40..200]
   [NULLFRAGTIMER=time] [NUMBER=number]
   [ONLINELIMIT={NONE|1..65535}]
   [OUTDATALIMIT={NONE|1..65535}] [PASSWORD=password]
   [PREDCHECK={CRC16|CRCCCITT}]
   [RECHALLENGE={ON=|OFF|360..3600}] [RESTART=time]
   [STACCHECK={LCB|SEQUENCE}] [STARENTITY=1..255]
   [TERMINATE={value|CONTINUOUS}]
   [TOTALDATALIMIT={NONE|1..65535}]
   [TYPE={DEMAND|PRIMARY|SECONDARY}] [UPRATE=0..100]
   [UPTIME=time] [USERNAME=username]
```

Description

The new **mssheader** parameter specifies the amount of space, in bytes, that is reserved for the header of a TCP packet. This amount is subtracted from the MTU of the interface to define the Maximum Segment Size (MSS). The default is 120 bytes.

The **mssheader** parameter may only be used with an Ethernet or VLAN physical interface (PPPoE).

Examples

To create a PPPoE interface that has a default MTU of 1492 with an MSS value of 1292, use the command:

```
cre ppp=0 over=eth0-any mssheader=200
```

create ppp template

Syntax

```
CREate PPP TEMPlate=template [COPY=template]
   [AUTHENTICATION={CHAP|EITHER|PAP|NONE}] [BAP={ON|OFF}]
   [BAPMODE={CALL|CALLBACK}] [CBDELAY=1..100]
   [CBMODE={ACCEPT|OFF|REQUEST}] [CBNUMBER=e164number]
   [CBOPERATION={E164NUMBER|USERAUTH}]
   [COMPALGORITHM={PREDICTOR|STACLZS}]
   [COMPRESSION={ON|OFF|LINK}] [DEBUGMAXBYTES=16..256]
   [DESCRIPTION=description] [DOWNRATE=0..100]
   [DOWNTIME=time] [ECHO={ON|OFF|period}]
   [ENCRYPTION={ON|OFF}] [FRAGMENT={ON|OFF}]
   [FRAGOVERHEAD=0..100] [IDLE={ON|OFF|time}]
   [INDATALIMIT={NONE|1..65535}] [IPPOOL={pool-name|NONE}]
   [IPREQUEST={ON|OFF}] [LOGIN={ALL|RADIUS|TACACS|USER}]
   [LQR={ON|OFF|period}] [MAGIC={ON|OFF}] [MAXLINKS=1..64]
   [MRU={ON|OFF|256..1656}] [MSSheader=40..200]
   [MTU=256..1500|256..1492] [MULTILINK={ON|OFF}]
   [NULLFRAGTIMER=time] [ONLINELIMIT={NONE|1..65535}]
   [OUTDATALIMIT={NONE|1..65535}] [PASSWORD=password]
   [PREDCHECK={CRC16|CRCCCITT}]
   [RECHALLENGE={ON|OFF|360..3600}] [RESTART=time]
   [STACCHECK={LCB|SEQUENCE}] [STARENTITY=1..255]
   [TERMINATE={value|CONTINUOUS}]
   [TOTALDATALIMIT={NONE|1..65535}] [UPRATE=0..100]
   [UPTIME=time] [USERNAME=username]
```

Description

The new **mssheader** parameter specifies the amount of space, in bytes, that is reserved for the header of a TCP packet. This amount is subtracted from the MTU of the interface to define the Maximum Segment Size (MSS). The default is 120 bytes.

The **mssheader** parameter may only be used with an Ethernet or VLAN physical interface (PPPoE).

Examples

To create a PPPoE template that uses the default MTU of 1000 and has an MSS value of 800, use the command:

```
cre ppp temp=1 mssheader=200
```

set ppp

Syntax

```
SET PPP==ppp-interface [OVER=physical-interface]
   [AUTHENTICATION={CHAP|EITHER|PAP|NONE}]
   [AUTHMODE={IN|OUT|INOUT}] [BAP={ON|OFF}]
   [BAPMODE={CALL|CALLBACK}] [CBDELAY=1..100]
   [CBMODE={ACCEPT|OFF|REQUEST}] [CBNUMBER=e164number]
   [CBOPERATION={E164NUMBER|USERAUTH}]
   [COMPALGORITHM={PREDICTOR|STACLZS}]
   [COMPRESSION={ON|OFF|LINK}]
   [CONFIGURE={value|CONTINUOUS}] [DEBUGMAXBYTES=16..256]
   [DESCRIPTION=description] [DOWNRATE=0..100]
   [DOWNTIME=time] [ECHO={ON|OFF|period}]
   [ENCRYPTION={ON|OFF}] [FRAGMENT={ON|OFF}]
   [FRAGOVERHEAD=0.100] [IDLE={ON|OFF|time}]
   [INDATALIMIT={NONE|1..65535}] [IPPOOL={pool-name|NONE}]
   [IPREQUEST={ON|OFF}] [LQR={ON|OFF|period}]
   [MAGIC={ON|OFF}] [MAXLINKS=1..64] [MODEM={ON|OFF}]
   [MRU={ON|OFF|256..1656}] [MSSheader=40..200]
   [NULLFRAGTIMER=time] [ONLINELIMIT={NONE|1..65535}]
   [OUTDATALIMIT={NONE|1..65535}] [PASSWORD=password]
   [PREDCHECK={CRC16|CRCCCITT}]
   [RECHALLENGE={ON|OFF|360..3600}] [RESTART=time]
   [STACCHECK={LCB|SEQUENCE}] [STARENTITY=1..255]
   [TERMINATE={value|CONTINUOUS}]
   [TOTALDATALIMIT={NONE|1..65535}]
   [TYPE={DEMAND|PRIMARY|SECONDARY}] [UPRATE=0..100]
   [UPTIME=time] [USERNAME=username]
```

Description

The new **mssheader** parameter specifies the amount of space, in bytes, that is reserved for the header of a TCP packet. This amount is subtracted from the MTU of the interface to define the Maximum Segment Size (MSS). The default is 120 bytes.

The **mssheader** parameter may only be used with an Ethernet or VLAN physical interface (PPPoE).

Examples

To set a PPPoE interface that has a default MTU of 1492 to use an MSS value of 1292, use the command:

```
set ppp=0 over=eth0-any mssheader=200
```

set ppp template

Syntax

```
SET PPP TEMPlate=template
   [AUTHENTICATION={CHAP|EITHER|PAP|NONE}] [BAP={ON|OFF}]
   [BAPMODE={CALL|CALLBACK}] [CBDELAY=1..100]
   [CBMODE={ACCEPT|OFF|REQUEST}] [CBNUMBER=e164number]
   [CBOPERATION={E164NUMBER|USERAUTH}]
   [COMPALGORITHM={PREDICTOR|STACLZS}]
   [COMPRESSION={ON|OFF|LINK}] [DEBUGMAXBYTES=16..256]
   [DESCRIPTION=description] [ECHO={ON|OFF|period}]
   [ENCRYPTION={ON|OFF}] [FRAGMENT={ON|OFF}]
   [FRAGOVERHEAD=0..100] [IDLE={ON|OFF|time}]
   [INDATALIMIT={NONE|1..65535}] [IPPOOL={pool-name|NONE}]
   [IPREQUEST={ON|OFF}] [LOGIN={ALL|RADIUS|TACACS|USER}]
   [LQR={ON|OFF|period}] [MAGIC={ON|OFF}] [MAXLINKS=1..64]
   [MRU={ON|OFF|256..1656}] [MSSheader=40..200]
   [MTU=256..1500|256..1492] [MULTILINK={ON|OFF}]
   [NULLFRAGTIMER=time] [ONLINELIMIT={NONE|1..65535}]
   [OUTDATALIMIT={NONE|1..65535}] [PASSWORD=password]
   [PREDCHECK={CRC16|CRCCCITT}]
   [RECHALLENGE={ON|OFF|360..3600}] [RESTART=time]
   [STACCHECK={LCB|SEQUENCE}] [STARENTITY=1..255]
   [TOTALDATALIMIT={NONE|1..65535}] [USERNAME=username]
```

Description

The new **mssheader** parameter specifies the amount of space, in bytes, that is reserved for the header of a TCP packet. This amount is subtracted from the MTU of the interface to define the Maximum Segment Size (MSS). The default is 120 bytes.

The **mssheader** parameter may only be used with an Ethernet or VLAN physical interface (PPPoE).

Examples

To set a PPPoE template that has an MSS value of 800, use the command:

```
set ppp temp=1 mssheader=200
```

show ppp pppoe

Syntax `SHow PPP PPPoe`

Description The output of this command includes a new field.

Figure 1: Example output from the **show ppp pppoe** command

```
PPPOE
------------------------------------------------------------
PPP1:
  Service Name ................. bob
  Peer Mac Address ............. 00-00-cd-00-ab-a3
  Session ID ................... a1a3
  Maximum Segment Size ......... 1292

  Access Concentrator Mode ..... Enabled

Services:
  bob
    Max sessions ................ 2
    Current Sessions ............ 1
    Template .................... 1
    MAC RADIUS Authentication ... YES
  carol
    Max sessions ................ 5
    Current Sessions ............ 0
    Template .................... 1
    MAC RADIUS Authentication ... YES

PPPOE Counters:
  Rejected PADI packets ...... 0
  Rejected PADO packets ...... 0
  Rejected PADR packets ...... 0
  Rejected PADS packets ...... 0
  Rejected PADT packets ...... 0
------------------------------------------------------------
```

Table 4: New parameters in the output of the **show ppp pppoe** command

Parameter	Meaning
Maximum Segment Size	The maximum number of bytes that the data payload may occupy in a TCP packet. This figure is derived by subtracting the clamped MSS header size from the MTU of the interface

show ppp template

Syntax SHow PPP TEMPLATE[=*template*] [DEBUG]

Description The output of this command includes a new field.

Figure 2: Example output from the **show ppp template** command

```
Template - Description
  Parameter                                          Value
-------------------------------------------------------------------------------
pppt0 - Template for calls from Head Office
  Multilink ..................................... ON
  Maximum links ................................. 4
  Bandwidth Allocation Protocol ................. ON
  Bandwidth Allocation Call Mode ................ CALL
  Multilink fragmentation ....................... OFF
  Acceptable Fragment Overhead (%)............... 5
  Null Fragment Timer (seconds).................. 3
  Idle Timer (seconds)........................... OFF
  Compression ................................... ON
  Compression Algorithm ......................... STACLZS
  Compression Checkmode ......................... LCB
  Encryption .................................... OFF
  Username ...................................... NOT SET
  Password ...................................... NOT SET
  Login Servers ................................. RADIUS,TACACS,USER
  IP Pool ....................................... NOT SET
  Request IP Address ............................ NO
  VJC ........................................... OFF
  Clamped MSS Header Size (bytes) ..... 200

Link
  Authentication ................................ NONE
  CHAP Rechallenge (max. period seconds)............. 900
  Callback Mode ................................. OFF
  Callback Operation ............................ USER
  Callback Number ............................... -
  Callback Delay (seconds)....................... 5
  Echo Timer (seconds)........................... 10
  LQR Timer (seconds)............................ 60
  Magic Number .................................. ON
  Maximum Receive Unit .......................... OFF
  Restart Timer (seconds) ....................... 3
Debug
  Maximum packet bytes to display ..... 32
-------------------------------------------------------------------------------
```

Table 5: New parameters in the output of the **show ppp template** command

Parameter	Meaning
Clamped MSS Header Size	The amount of space, in bytes, that is reserved for the header of a TCP packet. This amount is subtracted from the MTU of the interface to define the Maximum Segment Size (MSS).

Reflecting TOS onto L2TP-tunnelled Packets

Quality of Service (QoS) for L2TP-tunnelled packets on VPN networks has been enhanced. Software Version 2.7.5 enables the router or switch to reflect the TOS/DSCP field of the IP packet's header onto the encapsulating L2TP IP header.

The IP packet's TOS/DSCP field indicates the desired QoS for the IP packet. Copying this onto the encapsulating L2TP IP header means that the tunnelled packet reflects the original IP packet's QoS information. Networking equipment can then use this information to apply QoS to the encapsulated packet in the same way they would to the original packet.

You can turn on this feature for particular L2TP calls, using one of the commands:

```
ADD L2TP CALL=name [TOSreflect={ON|OFF|Yes|No|True|False}]
    [other-options...]

SET L2TP CALL=name [TOSreflect={ON|OFF|Yes|No|True|False}]
    [other-options...]
```

You can turn on this feature for particular L2TP tunnel destination IP addresses, using the command:

```
ADD L2TP IP=ipadd[-ipadd] PPPTemplate=ppp-template
    [TOSreflect={ON|OFF|Yes|No|True|False}]
    [other-options...]
```

You can turn on this feature for particular L2TP users, using one of the commands:

```
ADD L2TP USer={mapping|ALL|LOCAL|NONE|REMote}
    [TOSreflect={ON|OFF|Yes|No|True|False}]
    [other-options...]

SET L2TP USER={mapping|ALL|LOCAL|NONE|REMote}
    [TOSreflect={ON|OFF|Yes|No|True|False}]
    [other-options...]
```

Command changes

The following table summarises the modified commands (see **Command Reference Updates**).

Command	Change
add l2tp call	New **tosreflect** parameter
set l2tp call	New **tosreflect** parameter
show l2tp call	New **tosreflect** field
add l2tp ip	New **tosreflect** parameter
show l2tp ip	New **tosreflect** field
add l2tp user	New **tosreflect** parameter
set l2tp user	New **tosreflect** parameter
show l2tp user	New **tosreflect** field

Command Reference Updates

This section describes the changed portions of modified commands and output screens. For modified commands and output, new parameters and fields are shown in bold.

add l2tp call

Syntax

```
ADD L2TP CALL=name TYpe={ASYNc|ISDN|VIrtual} IP=ipadd
   REMotecall=name [DIAL=number] [NUMber={ON|OFF|STARTup}]
   [PASSword=password] [PRE13={ON|OFF}]
   [PRECedence={IN|OUT}] [SPeed=speed]
   [SUBAddress=subaddress]
   [TOSreflect={ON|OFF|Yes|No|True|False}]
```

Description The new **tosreflect** parameter specifies whether or not the TOS/DSCP field of a data packet within the L2TP tunnel should be reflected onto the encapsulated packet. This means that the tunnelled packet reflects the original packet's QoS information. The values **on**, **yes**, and **true** are equivalent. The values **off**, **no**, and **false** are equivalent.

add l2tp ip

Syntax

```
ADD L2TP IP=ipadd[-ipadd] PPPTemplate=ppp-template
   [NUMber={ON|OFF|STARTup}] [PRE13={ON|OFF}]
   [TOSreflect={ON|OFF|Yes|No|True|False}]
```

Description The new **tosreflect** parameter specifies whether or not the TOS/DSCP field of a data packet within the L2TP tunnel should be reflected onto the encapsulated packet. This means that the tunnelled packet reflects the original packet's QoS information. The values **on**, **yes**, and **true** are equivalent. The values **off**, **no**, and **false** are equivalent.

add l2tp user

Syntax

```
ADD L2TP USer={mapping|ALL|LOCAL|NONE|REMote}
   ACtion={DATABase|DNSLookup|IGNore|RADius}
   [IP=ipadd [POrt=port]] [NUMber={ON|OFF}]
   [PASSword=password] [PRE13={ON|OFF}] [PREFix=prefix]
   [TIMEOut=timeout]
   [TOSreflect={ON|OFF|Yes|No|True|False}]
```

Description The new **tosreflect** parameter specifies whether or not the TOS/DSCP field of a data packet within the L2TP tunnel should be reflected onto the encapsulated packet. This means that the tunnelled packet reflects the original packet's QoS information. The values **on**, **yes**, and **true** are equivalent. The values **off**, **no**, and **false** are equivalent.

set l2tp call

Syntax

```
SET L2TP CALL=name [DIAL=number] [IP=ipadd]
   [NUMber={ON|OFF|STARTup}] [PASSword=password]
   [PRE13={ON|OFF}] [PRECedence={IN|OUT}]
   [REMotecall=name] [SPeed=speed] [SUBAddress=subaddress]
   [TOSreflect={ON|OFF|Yes|No|True|False}]
   [TYpe={ASYNc|ISDN|VIrtual}]
```

Description The new **tosreflect** parameter specifies whether or not the TOS/DSCP field of a data packet within the L2TP tunnel should be reflected onto the encapsulated packet. This means that the tunnelled packet reflects the original packet's QoS information. The values **on**, **yes**, and **true** are equivalent. The values **off**, **no**, and **false** are equivalent.

set l2tp user

Syntax

```
SET L2TP USer={mapping|ALL|LOCAL|NONE|REMote}
   [ACtion={DATABase|DNSLookup|IGNore|RADius}]
   [IP=ipadd [POrt=port]] [NUMber={ON|OFF}]
   [PASSword=password] [PRE13={ON|OFF}] [PREFix=prefix]
   [TIMEOut=timeout]
   [TOSreflect={ON|OFF|Yes|No|True|False}]
```

Description The new **tosreflect** parameter specifies whether or not the TOS/DSCP field of a data packet within the L2TP tunnel should be reflected onto the encapsulated packet. This means that the tunnelled packet reflects the original packet's QoS information. If you specify **on**, **yes** or **true**, the TOS/DSCP field is reflected. If you specify **off**, **no** or **false** the TOS/DSCP field is not reflected.

show l2tp call

Syntax `SHow L2TP CALL[=name]`

Description This command displays information about the specified call definition or all defined calls.

Figure 3: Example output from the **show l2tp call** command

```
L2TP Call Information

------------------------------------------------------------
Name : test
  Type ..................... virtual
  Precedence ............... out
  Sequence numbering ...... off
  Remote is pre draft13 ... on
  Speed .................... 64000
  IP address ............... 192.168.1.2
  Password ................. not set
  Remote callname ......... test
  Dial ..................... not set
  Subaddress ............... not set
  ToS Reflect ............. off
```

Table 6: New parameter in the output of the **show l2tp call** command

Parameter	Meaning
ToS Reflect	Whether the TOS/DSCP field of data packets within the L2TP tunnel is reflected onto the encapsulated packet.

show l2tp ip

Syntax `SHow L2TP IP`

Description This command displays the associations between PPP templates and remote L2TP peers.

Figure 4: Example output from the **show l2tp ip** command

```
L2TP IP Range Information
------------------------------------------------------------
IP Range ........................ 192.168.1.2
  PPP template .................. 1
  Sequence numbering ............ off
  Pre-draft 13 support .......... off
  ToS Reflect ................... off
------------------------------------------------------------
```

Table 7: New parameter in the output of the **show l2tp ip** command

Parameter	Meaning
ToS Reflect	Whether the TOS/DSCP field of data packets within the L2TP tunnel is reflected onto the encapsulated packet.

show l2tp user

Syntax `SHow L2TP USER[=`*`mapping`*`]`

Description This command displays attributes of the specified user mapping entry or all defined entries.

Figure 5: Example output from the **show l2tp user** command

```
L2TP User Information
------------------------------------------------------------
User : dataman
  Action ..................... database
  Password ................... not set
  Maximum timeout ........... 20
  Sequence Numbering ........ on
  Remote is pre draft13 .... on
  Remote IP .................. 192.168.1.2
  Remote Port ............... 1701
  ToS Reflect ............... off
```

Table 8: New parameter in output of the **show l2tp user** command

Parameter	Meaning
ToS Reflect	Whether the TOS/DSCP field of data packets within the L2TP tunnel is reflected onto the encapsulated packet.

New Speed and Duplex Mode Options

Software Version 2.7.5 extends the speed and duplex mode options for switch ports.

Fixed Speed and Autonegotiated Duplex Mode

Software Version 2.7.5 enables you to fix the speed of copper switch ports to 10 or 100Mbps and still autonegotiate the duplex mode.

To fix the speed and autonegotiate the duplex mode, use the new **10mauto** or **100mauto** options in the command:

```
set switch port={port-list|all}
   speed={autonegotiate|10mauto|10mhauto|10mhalf|10mfauto|
   10mfull|100mauto|100mhauto|100mhalf|100mfauto|100mfull|
   1000mhauto|1000mhalf|1000mfauto|1000mfull}
   [other-options...]
```

The options that apply depend on the router or switch model and the type of port. The new options apply to all copper switch ports and SFPs that are capable of operating at 10 or 100Mbps.

Command Changes

The following table summarises the modified command (see **Command Reference Updates**)

Command	Change
set switch port	New **10mauto** and **100mauto** options

Fixed 1000Mbps Full Duplex Mode

Software Version 2.7.5 also enables you to force ports on AT-9900 series switches to operate at 1000Mbps in full duplex mode, instead of autonegotiating with their link partners.

To fix the speed at 1000Mbps and the duplex mode at full duplex, use the new **1000mfull** option in the command:

```
set switch port={port-list|all}
   speed={autonegotiate|10mauto|10mhauto|10mhalf|10mfauto|
   10mfull|100mauto|100mhauto|100mhalf|100mfauto|100mfull|
   1000mfull|1000mfauto} [other-options...]
```

For different types of port on AT-9900 series switches, the valid speed options are shown in the following table.

Port type	Speed parameter options
RJ-45 copper ports	autonegotiate 10mauto, 10mhauto, 10mhalf, 10mfauto, 10mfull 100mauto, 100mhauto, 100mhalf, 100mfauto, 100mfull 1000mfull, 1000mfauto
copper SFPs	autonegotiate 10mauto, 10mhauto, 10mhalf, 10mfauto, 10mfull 100mauto, 100mhauto, 100mhalf, 100mfauto, 100mfull 1000mfull, 1000mfauto
fibre SFPs	autonegotiate 1000mfull, 1000mfauto

Command Changes

The following table summarises the modified command (see **Command Reference Updates**)

Command	Change
set switch port	New **1000mfull** option

Command Reference Updates

This section describes the modified command. The new options are shown in bold.

set switch port

Syntax

```
SET SWItch POrt={port-list|ALL}
   [SPeed={AUTOnegotiate|10MAUTo|10MHAUto|10MHALf|
   10MFAuto|10MFUll|100MAUto|100MHAUto|100MHALf|100MFAuto|
   100MFUll|1000MHAUto|1000MHALf|1000MFAUto|1000MFUll}]
   [other-options...]
```

Description

On the **speed** parameter:

- The new **10mauto** option sets the port speed to 10Mbps. The port autonegotiates the duplex mode.
- The new **100mauto** option sets the port speed to 100Mbps. The port autonegotiates the duplex mode.
- The new **1000mfull** option sets the port speed to 1000Mbps and the duplex mode to full duplex. The port uses this speed and duplex mode instead of autonegotiating.

The speed and duplex mode options that apply depend on the router or switch model and the type of port.

Disabling IP ARP Cache Refreshing

Software Release 2.7.5 enables you to disable IP ARP cache refreshing. Previously, whenever an IP ARP entry was used (hit), the cache entry was refreshed and the ageing timer reset.

To disable automatic refreshing, use the command

```
set ip arp refresharp={off|no|false}
```

Command Changes

The following table summarises the modified commands (see **Command Reference Updates**)

Command	Change
set ip arp refresharp	New command
show ip	New field in output

Command Reference Updates

This section describes the new command and the changed portion of the modified command output screen. For modified output, the new field is shown in bold.

set ip arp refresharp

Syntax `SET IP ARP REFresharp={ON|YES|True|OFF|NO|False}`

Description This command specifies whether IP ARP entries are refreshed in the ARP cache as they are used (hit).

The **refresharp** parameter specifies whether to refresh IP ARP entries in the cache and restart the aging timer when an entry is used. The values **on**, **yes** and **true** are equivalent. The values **off**, **no** and **false** are equivalent. The default is **on**.

show ip

Syntax `SHow IP`

Description This command displays general configuration information regarding the router or switch (Figure 6 on page 21, Table 9 on page 21).

Figure 6: Example output from the **show ip** command

```
IP Module Configuration
-------------------------------------------------------------

Module Status ................... ENABLED
IP Packet Forwarding ............ ENABLED
IP Echo Reply ................... ENABLED
Debugging ....................... DISABLED
IP Fragment Offset Filtering ... ENABLED
Default Name Servers
  Primary Name Server .......... 192.168.1.1 (ppp0)
  Secondary Name Server ........ Not Set
Name Server ..................... 192.168.1.1 (ppp0)
Secondary Name Server ........... Not Set
Source-Routed Packets ........... Discarded
Remote IP address assignment ... DISABLED
DNS Relay ....................... DISABLED
IP ARP LOG ...................... ENABLED
IP ARP refresh by hit .......... ENABLED
.
.
.
```

Table 9: New parameter in output of the **show ip** command

Parameter	Meaning
IP ARP refresh by hit	Whether ARP entry refreshing is enabled.

DHCP Option 82 Relay

The existing DHCP and BOOTP functionality has been enhanced to include the addition, removal and monitoring of DHCP Option 82. Option 82 is also called the Relay Agent Information option.

Option 82 is inserted by the DHCP relay agent into the DHCP options field when forwarding client-originated BOOTP/DHCP packets to a DHCP server. DHCP servers that are configured to recognise Option 82 may use the information to implement IP addresses, or other parameter assignment policies, based on the network location of the client device.

For more information about Option 82, see RFC 3046.

The BOOTP relay function has been enhanced. Option 82 can now be:

- added to packets relayed from the DHCP client to DHCP server
- removed from packets relayed from DHCP server to DHCP client
- checked from sources closer to the client.

Additional commands have also been added to enable and disable Option 82.

Command changes

The following table summarises the new and modified commands (see **Command Reference Updates**).

Command	Change
purge bootp relay	New result on entry of command.
show bootp relay	New DHCP Option 82 fields **Insertion status**, **Check**, **Reforwarding policy** and **Debugging**
enable bootp relay option82	New command
disable bootp relay option82	New command
set bootp relay option82	New command
set bootp relay option82 port	New command
show bootp relay port	New command

Command Reference Updates

This section describes each new command and the changed portions of modified commands and output screens. For modified commands and output, new parameters, options and fields are shown in bold.

enable bootp relay option82

Syntax `ENAble BOOTp RELAy OPTion82 [DEBug]`

Description This command enables the DHCP relay agent to insert DHCP Option 82 into the DHCP options field when forwarding client-originated BOOTP/DHCP packets to a DHCP server.

Use the **debug** parameter to enable Option 82 related debug.

Example To enable the insertion of Option 82, use the command:

```
ena boot rela opt
```

disable bootp relay option82

Syntax `DISable BOOTp RELAy OPTion82 [DEBug]`

Description This command disables the insertion of DHCP Option 82 into the DHCP options field when forwarding client-originated BOOTP/DHCP packets to a DHCP server.

Use the **debug** parameter to disable Option 82 related debug.

Example To disable the insertion of Option 82, use the command:

```
dis boot rela opt
```

purge bootp relay

Syntax `PURge BOOTp RELAy`

Description This command now purges the BOOTP relay configuration. The BOOTP module is disabled and all configuration data is purged.

set bootp relay option82

Syntax

```
SET BOOTp RELAy OPTion82
   [CHEck={YES|NO|ON|OFF|True|False}]
   [POLIcy={DROP|KEEP|REPLACE}]
```

Description

This command defines the checking and re-forwarding settings used by DHCP Option 82. When Option 82 is enabled, the DHCP relay agent inserts Option 82 information into the DHCP options field when forwarding client-originated BOOTP/DHCP packets to a DHCP server. Option 82 must be enabled with the **enable bootprelay option 82** command for the settings you specify to take effect.

Use the **check** parameter to specify whether the Option 82 information that is returned from the DHCP server is to be checked or not. When checking is enabled, server DHCP packets that contain valid Option 82 information are forwarded to the client, and packets that do not contain valid Option 82 information are dropped. If **yes** is specified, checking is enabled. The values **yes**, **on**, and **true** are equivalent. If **no** is specified, Option 82 information returned from the DHCP server is not checked. The values **no**, **off**, and **false** are equivalent. The default is **yes**.

Use the **policy** parameter to specify the re-forwarding policy of client DHCP packets that contain Option 82 information. If **drop** is specified, client DHCP packets that contain Option 82 information are dropped. If **keep** is specified, the packet keeps its existing Option 82 information. If **replace** is specified, the existing Option 82 information is replaced with that of the local device. The default is **replace**.

Example

To set the re-forwarding policy to drop client DHCP packets with Option 82 information, use the command:

```
set boot rela opt poli=drop
```

set bootp relay option82 port

Syntax

```
SET BOOTp RELAy OPTion82 POrt={port-list|ALL}
   [SUBScriberid=subscriber-id]
   [TRusted={YES|NO|ON|OFF|True|False}]
```

where:

- *port-list* is a port number, a range of port numbers (specified as *n-m*), or a comma-separated list of port numbers and/or ranges. Port numbers start at 1 and end at *m*, where m is the highest numbered Ethernet switch port, including uplink ports.
- *subscriber-id* is a character string from 0 to 50 characters long. Valid characters are any alphanumeric characters. If string contains spaces, it must be in double quotes. Wildcards are not allowed.

Description

This command defines the DHCP Relay Agent port settings for DHCP Option 82. When Option 82 is enabled, the Relay Agent inserts Option 82 information into the DHCP options field when forwarding client-originated BOOTP/DHCP packets to a DHCP server. Option 82 must be enabled with the **enable bootprelay option 82** command for the port settings you specify to take effect.

Use the **port** parameter to specify the port to use for this command. If **all** is specified, this command is applied to all ports on the device.

Use the **subscriberid** parameter to specify the subscriber-ID for the port defined in **port=**. If specified, the subscriber-ID sub-option is included in the Option 82 field of client DHCP packets received on the specified port. The default is no subscriber-ID.

NOTE If you specify an empty string in the **subscriberid** parameter, then the subscriber-ID sub-option is not included in the Option 82 field of client DHCP packets forwarded from the specified port. Use this method to delete a subscriber-ID from a port.

Use the **trusted** parameter to specify how the router or switch handles client DHCP packets that contain Option 82 information, but which have the giaddr field set to 0. If you specify **yes**, the defined port is considered to be a trusted source of Option 82 information, and packets with Option 82 information and a giaddr of 0 are forwarded according to normal BOOTP Relay operation. The values **yes**, **on**, and **true** are equivalent. If you specify **no**, packets are dropped that contain DHCP Option 82 information and with the giaddr field set to 0. The values **no**, **off**, and **false** are equivalent. The default is **no**.

Example

To set all ports as trusted, use the command:

```
set boot rela opt po=all tr=yes
```

show bootp relay

Syntax `SHow BOOTp RELAy`

Description This command displays the current configuration of the BOOTP Relay Agent.

Figure 7: Example output from the **show bootp relay** command

```
BOOTP Relaying Agent Configuration.

Status ..................... Disabled
Maximum hops ............... 4

DHCP Option 82:
  Insertion status ......... Enabled
  Check .................... Yes
  Reforwarding policy ...... Replace
  Debugging ................ Disabled

BOOTP Relay Destinations
------------------------------------------------------------
No relay destinations configured...
------------------------------------------------------------

BOOTP Counters

  InPackets ............... 0  OutPackets ................ 0
  InRejects ............... 0
  InRequests .............. 0
  InReplies ............... 0
```

Table 10: New parameters in the output of the **show bootp relay** command

Parameter	Meaning
Insertion Status	The status of DHCP Option 82 insertion, either Enabled or Disabled.
Check	Whether DHCP Option 82 information returned from the DHCP server is being checked, either Yes or No.
Reforwarding policy	The re-forwarding policy of client DHCP packets, either Replace, Keep, or Drop.
Debugging	The status of DHCP Option 82 debugging, either Enabled or Disabled.

show bootp relay port

Syntax `SHow BOOTp RELAy POrt[={`*`port-list`*`|ALL}]`

where:

- *port-list* is a port number, a range of port numbers (specified as *n-m*), or a comma-separated list of port numbers and/or ranges. Port numbers start at 1 and end at *m*, where m is the highest numbered Ethernet switch port, including uplink ports.

Description This command displays port-related information about the BOOTP Relay port settings.

Use the **port** parameter to specify the port to display BOOTP Relay information for. If **all** is specified, information about all ports on the device is displayed.

Figure 8: Example output from the **show bootp relay port** command

```
BOOTP Relay Port Information:
---------------------------------------
Port ..................... 1
Trusted ..................... No
Subscriber-ID .............. user12332

Port ..................... 2
Trusted .....................Yes
Subscriber-ID ..............
---------------------------------------
```

Table 11: Parameters in output of the **show bootp relay** command

Parameter	Meaning
Port	The number of the switch port
Trusted	Whether the port is trusted, either Yes or No.
Subscriber-ID	The subscriber-ID assigned to the port.

IGMP Enhancements

Software Version 2.7.5 includes the following enhancements for IGMP:

- **Fast Leave**
- **Filtering and Throttling**

This section describes each enhancement, then the new and modified commands in **Command Reference Updates**.

Fast Leave

When an IGMP group-specific leave message is received on a port, IGMP Snooping stops the transmission of the group multicast stream after a timeout period. The **lmqi** (Last Member Query Interval) and **lmqc** (Last Member Query Count) parameters of the **set ip igmp** command set the timeout period. This timeout period allows other hosts on the port to register their membership of the multicast group and continue receiving the stream.

The Fast Leave feature allows IGMP Snooping to stop the transmission of a group multicast stream from a port immediately it receives a leave message, without waiting for the timeout period.

Use the Fast Leave feature to improve bandwidth management on ports that are connected to a single host. Fast Leave should not be configured on a port that has multiple hosts attached because it may adversely affect multicast services to some hosts.

Fast Leave processing is disabled by default. To enable Fast Leave on a specific VLAN, or all VLANs on the router or switch, use the command:

```
set igmpsnooping fastleave={on|yes|true}
    [interface=interface]
```

To disable Fast Leave on a specific VLAN, or all VLANs on the router or switch, use the command:

```
set igmpsnooping fastleave={off|no|false}
    [interface=interface]
```

To display the current state of Fast Leave processing on a specific VLAN, or all VLANs on the router or switch, use the command:

```
show igmpsnooping [vlan={vlan-name|1..4094}]
```

Command Changes

The following table summarises the new and modified commands:

Command	Change
set igmpsnooping fastleave	New command
show igmpsnooping	New **Fast Leave** field

Filtering and Throttling

IGMP filtering and throttling let you control the distribution of multicast services on each switch port. IGMP filtering controls which multicast groups a host on a switch port can join. IGMP throttling limits the number of multicast groups that a host on a switch port can join.

IGMP filtering and throttling are applied to multicast streams forwarded by IGMP, IGMP Snooping, or MVR.

IGMP filtering and throttling can be applied separately, or together, on the same switch port. Filtering is applied first, and any multicast group memberships passed by the filter are further subjected to the limits imposed by throttling.

IGMP Filters

An IGMP filter controls the multicast groups that a port can be a member of by filtering IGMP Membership Reports from hosts attached to the port.

Static associations of switch ports and multicast groups are not affected by IGMP filtering.

Format of a filter

An IGMP filter consists of zero or more entries. An entry consists of:

- A multicast address range to match against. Address ranges in multiple entries can overlap.
- An action to take (include or exclude) when a Membership Report matches the multicast address range.

Each filter has an implicit exclude entry as the last entry in the filter.

Matching against a filter

When an IGMP filter is applied to a switch port:

1. IGMP matches Membership Reports from the switch port against each entry in the filter applied to the port.
2. If the group address in the Membership Report matches the multicast address range of a filter entry, IGMP takes the action specified by the filter entry:
   - If the action is **include**, IGMP processes the Membership Report as normal. The port is able to join the multicast group.
   - If the action is **exclude**, IGMP excludes the Membership Report from normal IGMP processing and discards the packet. The port is not able to join the multicast group.

   Filter processing stops when a match is found.
3. If the group address in the Membership Report does not match any entry in the filter, IGMP excludes the Membership Report from normal IGMP processing and discards the packet. The port is not able to join the multicast group.

Applying an empty IGMP filter (a filter with no entries) to a switch port blocks all Membership Reports because of the filter's implicit exclude entry.

Order of entries

The order of entries in a filter is important. When IGMP tries to match a Membership Report to a filter, it performs a linear search of the filter to find a matching entry. Each entry is tried in turn, and processing stops at the first match found.

Address ranges can overlap. If the address range of an entry falls entirely within the address range of another entry, the entry with the smaller address range should appear first in the filter. Otherwise it will never be matched against a Membership Report.

Performance can be improved by arranging the entries in a filter to achieve the earliest possible match.

Configuring IGMP filters

To configure an IGMP filter, you must create the filter and then apply it to one or more switch ports.

To do this, first create the filter, using the command:

```
create igmp filter=filter-id
```

Then add one or more entries to the filter, using the command:

```
add igmp filter=filter-id groupaddress=ipadd[-ipadd]
    [action={include|exclude}] [entry=1..65535]
```

Finally, apply the filter to a switch port, using the command:

```
set switch port={port-list|all} igmpfilter=filter-id
    [other-options...]
```

You can apply an IGMP filter to more than one switch port, but a single switch port can have only one IGMP filter assigned to it.

To delete or modify an entry in a filter, use the commands:

```
delete igmp filter=filter-id entry=1..65535
```

```
set igmp filter=filter-id entry=1..65535
    groupaddress=ipadd[-ipadd] action={include|exclude}
```

To remove a filter from a switch port, use the command:

```
set switch port={port-list|all} igmpfilter=none
    [other-options...]
```

To destroy a filter, first remove the filter from all ports that it is applied to, then use the command:

```
destroy igmp filter=filter-id
```

To display information about IGMP filters, use the command:

```
show igmp filter=filter-id
```

To display the IGMP filter assigned to a switch port, use the command:

```
show switch port[={port-list|all}]
```

IGMP Throttling

IGMP throttling controls the maximum number of multicast groups that a port can join. When the number of multicast group memberships associated with a switch port reaches the limit set, further Membership Reports are subject to a throttling action—deny or replace.

If you configure a throttling action of **deny**, when the multicast group membership associated with the port reaches the set limit, additional Membership Reports from that switch port are denied until old membership entries are aged out.

If you configure a throttling action of **replace**, when the multicast group membership associated with the port reaches the set limit, additional Membership Reports from that switch port replace existing membership entries.

Static associations of switch ports and multicast groups are counted in the number of multicast group memberships, but they are not affected by the throttling action.

Configuring IGMP throttling

To enable IGMP throttling on a switch port, set the maximum number of group memberships and the throttling action to take, by using the command:

```
set switch port={port-list|all} igmpmaxgroup=1..65535
   igmpaction={deny|replace} [other-options...]
```

To disable IGMP throttling on a switch port, set the maximum number of group memberships to **none**, by using the command:

```
set switch port={port-list|all} igmpmaxgroup=none
   [other-options...]
```

To display the IGMP throttling settings for a switch port, use the command:

```
show switch port[={port-list|all}]
```

Command Changes

The following table summarises the new and modified commands:

Command	Change
IGMP Filtering	
add igmp filter	New command
create igmp filter	New command
delete igmp filter	New command
destroy igmp filter	New command
set igmp filter	New command
show igmp filter	New command
set switch port	New **igmpfilter** parameter
show switch port	New **IGMP Filter** field
IGMP Throttling	
set switch port	New **igmpmaxgroup** parameter New **igmpaction** parameter
show switch port	New **Max-groups/Joined** field New **IGMP Max-groups Action** field

Command Reference Updates

This section describes each new command and the changed portions of modified commands and output screens. For modified commands and output, new parameters, options and fields are shown in bold.

add igmp filter

Syntax

```
ADD IGMP FILter=filter-id GROupaddress=ipadd[-ipadd]
   [ACtion={INCLude|EXCLude}] [ENTry=1..65535]
```

where:

- *filter-id* is a decimal number in the range 1 to 99.
- *ipadd* is an IP address in dotted decimal notation.

Description

This command adds an entry to an IGMP filter. IGMP filters control a port's membership of multicast groups by filtering Membership Reports received from hosts attached to the port.

The filter must be applied to a switch port using the **set switch port** command to take effect.

The **filter** parameter specifies the number of the filter to add the entry to. The specified filter must have been created previously using the **create igmp filter** command.

The **groupaddress** parameter specifies an IP multicast group address, or a range of IP multicast group addresses to match. The IP addresses must be multicast addresses.

The **action** parameter specifies the action to take when an IGMP Membership Report group address matches the value of **groupaddress**. If you specify **include**, Membership Reports matching **groupaddress** are processed as normal by IGMP. If you specify **exclude**, Membership Reports matching **groupaddress** are excluding from processing by IGMP, and the packets are discarded. The default is **include**.

If an IGMP filter contains at least one entry, then Membership Reports for group addresses that do not match any entries in the filter are implicitly excluded and the packets are discarded.

The **entry** parameter specifies the position of the entry in the filter, and identifies the entry in the filter. The specified entry number must not already be used by another entry. If you do not specify an entry number, the entry is added after the last entry in the filter if there is a free position, or in the last unused position if the last position is already in use.

Examples

To add an entry to filter 6 to accept Membership Reports for multicast group addresses in the range 229.1.1.2 to 230.1.2.3, use the command:

```
add igmp fil=6 gro=229.1.1.2-230.1.2.3
```

To add an entry at position 16 in filter 3 to deny Membership Reports for multicast group addresses in the range 231.1.1.20 to 231.1.5.3, use the command:

```
add igmp fil=3 ent=16 gro=231.1.1.20-231.1.5.3 ac=excl
```

create igmp filter

Syntax `CREate IGMP FILter=`*`filter-id`*

where:

- *filter-id* is a decimal number in the range 1 to 99.

Description This command creates an IGMP filter. IGMP filters control a port's membership of multicast groups by filtering Membership Reports received from hosts attached to the port.

The **filter** parameter specifies the number of the filter to create, and is used to identify the filter. A filter with the specified number must not already exist.

You can add entries to the filter to match specific multicast groups, using the **add igmp filter** command.

You must apply the filter to a switch port using the **set switch port** command, before the filter takes effect. Applying an empty IGMP filter (a filter with no entries) to a switch port blocks all Membership Reports because of the filter's implicit exclude entry.

Examples To create a filter with a filter ID of 6, use the command:

```
cre igmp fil=6
```

delete igmp filter

Syntax `DELete IGMP FILter=`*`filter-id`* `ENTry={1..65535|ALL}`

where:

- *filter-id* is a decimal number in the range 1 to 99.

Description This command deletes the specified entry or all entries from an IGMP filter.

The **filter** parameter specifies the number of the filter that the entry belongs to. A filter with the specified number must already exist.

The **entry** parameter specifies the entry to delete. The specified entry must exist. If you specify **all**, then all entries are deleted from the filter.

Examples To delete entry 21 from filter 5, use the command:

```
del igmp fil=5 entry=21
```

destroy igmp filter

Syntax `DESTroy IGMP FILter=`*`filter-id`*

where:

- *filter-id* is a decimal number in the range 1 to 99.

Description This command destroys an IGMP filter and all entries in the filter. IGMP filters control a port's membership of multicast groups by filtering Membership Reports received from hosts attached to the port.

The **filter** parameter specifies the number of the filter to destroy. A filter with the specified number must already exist.

You should remove the filter from any ports before you destroy the filter. Use the **show switch port** command to see which ports the filter is applied to, and the **set igmp filter** command to remove the filter from any ports.

Examples To destroy filter 6, use the command:

```
des igmp fil=6
```

set igmp filter

Syntax
```
SET IGMP FILter=filter-id ENTry=1..65535
   [GROupaddress=ipadd[-ipadd]] [ACtion={INCLude|EXCLude}]
```

where:

- *filter-id* is a decimal number in the range 1 to 99.
- *ipadd* is an IP address in dotted decimal notation.

Description This command modifies an entry in an IGMP filter. IGMP filters control a port's membership of multicast groups by filtering Membership Reports received from hosts attached to the port.

The **filter** parameter specifies the number of the filter that the entry belongs to. A filter with the specified number must already exist.

The **entry** parameter specifies the entry to modify. An entry with the specified number must already exist.

The **groupaddress** parameter specifies an IP multicast group address, or a range of IP multicast group addresses to match. The IP addresses must be multicast addresses.

The **action** parameter specifies the action to take when an IGMP Membership Report group address matches the value of **groupaddress**. If you specify **include**, Membership Reports matching **groupaddress** are processed as normal by IGMP. If you specify **exclude**, Membership Reports matching **groupaddress** are excluding from processing by IGMP, and the packets are discarded. The default is **include**.

If an IGMP filter contains at least one entry, then Membership Reports for group addresses that do not match any entries in the filter are implicitly excluded and the packets are discarded.

Examples To change the group address for entry 12 in filter 6 to the range 229.1.1.2 to 230.1.2.3, use the command:

```
set igmp fil=6 ent=12 gro=229.1.1.2-230.1.2.3
```

To change entry 1 in filter 2 to accept Membership Reports for multicast group addresses matching the entry's group address range, use the command:

```
set igmp fil=2 ent=1 ac=incl
```

set igmpsnooping fastleave

Syntax `SET IGMPSNooping Fastleave={ON|OFF|YES|NO|True|False} [INTerface=`*`interface`*`]`

where *interface* is an interface name formed by concatenating a Layer 2 interface type ('vlan') and an interface instance.

Description This command enables or disables Fast Leave processing for IGMP Snooping. Fast Leave should not be configured on a port that has multiple hosts attached because it may adversely affect multicast services to some hosts.

The **fastleave** parameter specifies whether Fast Leave processing is enabled or disabled. If you specify **on**, **yes** or **true** then Fast Leave processing is enabled on the specified VLAN or all VLANs. If you specify **off**, **no** or **false** then Fast Leave processing is disabled on the specified VLAN or all VLANs. The default is **off**.

The **interface** parameter specifies the VLAN on which Fast Leave processing is to be enabled or disabled. If you do not specify an interface then the setting applies to all VLANs.

Examples To enable IGMP Snooping Fast Leave processing on VLAN 'vlan2', use the command:

```
set igmpsn f=on int=vlan2
```

To enable IGMP Snooping Fast Leave processing on all VLANs, use the command:

```
set igmpsn f=on
```

set switch port

Syntax (AR400, AR700)

```
SET SWItch POrt={port-list|ALL} [BCLimit={NONE|limit}]
   [DESCription=description] [DLFLimit={NONE|limit}]
   [IGMPACtion={DENY|REPlace}]
   [IGMPFIlter={NONE|filter-id}]
   [IGMPMAxgroup={NONE|1..65535}] [INFILTering=OFF|ON]
   [MCLimit={NONE|limit}] [POLarity={MDI|MDIX}]
   [SPeed={AUTOnegotiate|10MHALf|10MFUll|10MHAUto|10MFAuto
   |100MHALf|100MFUll|100MHAuto|100MFAuto|1000MFull|1000MF
   Auto}]
```

Syntax (Rapier, AT-8600, AT-8700XL, AT-8800)

```
SET SWItch POrt={port-list|ALL} [ACCeptable={ALL|VLAN}]
   [BCLimit={NONE|limit}] [DESCription=description]
   [DLFLimit={NONE|limit}]
   [EGResslimit={NONE|DEFault|0|1000..127000|8..1016}]
   [IGMPACtion={DENY|REPlace}]
   [IGMPFIlter={NONE|filter-id}]
   [IGMPMAxgroup={NONE|1..65535}] [INFILTering={OFF|ON}]
   [INGresslimit={NONE|DEFAULT|0|64..127000|8..1016}]
   [LEARn={NONE|0|1..256]
   [INTRusionaction={DISable|DIScard|TRap}]
   [MCLimit={NONE|limit}] [MIRRor={BOTH|NONE|RX|TX}]
   [MODe={AUTOnegotiate|MASTer|SLAve}]
   [MULTicastmode={A|B|C}]
   [SPeed={AUTOnegotiate|10MHALF|10MFULL|10MHAUTO|10MFAUTO
   |100MHALF|100MFULL|100MHAUTO|100MFAUTO|1000MHALF|1000MF
   ULL|1000MHAUTO|1000MFAUTO}]
```

Syntax (AT-8900, AT-9900)

```
SET SWItch POrt={port-list|ALL} [ACCeptable={ALL|VLAN}]
   [BCLimit={NONE|limit] [DESCription=description]
   [EGResslimit={bandwidth|DEFault}]
   [IGMPACtion={DENY|REPlace}]
   [IGMPFIlter={NONE|filter-id}]
   [IGMPMAxgroup={NONE|1..65535}] [INFILTering={OFF|ON}]
   [INTRusionaction={DISable|DIScard|TRap}]
   [LEARn={NONE|0|1..256] [MIRRor={BOTH|NONE|RX|TX}]
   [MODe={AUTOnegotiate|MASTer|SLAve}]
   [POLarity={MDI|MDIX}] [RELearn={OFF|ON}]
   [SPeed={AUTOnegotiate|10MHALf|10MFUll|10MHAUto|10MFAuto
   |100MHALf|100MFUll|100MHAUto|100MFAuto|1000MFUll|1000MF
   AUto}] [THRASHLimit={NONE|1..65536}]
   [THRASHRefill=1..65536]
```

Syntax (AT-9800)

```
SET SWItch POrt={port-list|ALL} [ACCeptable={ALL|VLAN}]
   [DESCription=description]
   [EGResslimit={bandwidth|DEFault}] [FClength=length]
   [IGMPACtion={DENY|REPlace}]
   [IGMPFIlter={NONE|filter-id}]
   [IGMPMAxgroup={NONE|1..65535}]
   [INTRusionaction={DISable|DIScard|TRap}]
   [JUmbo={ON|OFF|packetsize] [LEARn={NONE|0|1..256]
   [MIRRor={BOTH|NONE|RX|TX}]
   [MODe={AUTOnegotiate|MASTer|SLAve}] [RELearn={OFF|ON}]
   [SPeed={AUTOnegotiate|10MHALf|10MFUll|10MHAUto|10MFAuto
   |100MHALf|100MFUll|100MHAUto|100MFAuto|1000MHALf|1000MF
   Ull|1000MHAUto|1000MFAUto}]
```

where:

- *port-list* is a port number, range (specified as *n-m*), or comma-separated list of numbers and/or ranges. Port numbers start at 1 and end at *m*, where *m* is the highest numbered switch port, including uplink ports.
- *limit* is a decimal number, from 0 to the maximum value of the limit variable based on the particular switch hardware.
- *description* is a string 1 to 47 characters long. Valid characters are any printable characters.
- *bandwidth* is the maximum bandwidth available to the port in kbps, specified in multiples of 64 kbps.
- *length* is a physical length measured in metres.
- *packetsize* is a single decimal number.
- *port-list* is a port number, range (specified as *n-m*), or comma-separated list of numbers and/or ranges. Port numbers start at 1 and end at *m*, where *m* is the highest numbered switch port. Ports are identified either by a port number or a card.port number. See *Port Numbering* in the Switching chapter of the Software Reference for more information.

Description

This command modifies the value of parameters for switch ports.

The new **igmpaction** parameter specifies the action to take when the number of multicast group memberships associated with the port reaches the limit set by **igmpmaxgroup**. If you specify **deny**, then additional Membership Reports are discarded until existing group memberships age out. If you specify **replace**, then additional membership entries will replace existing membership entries. The default is **deny**.

The new **igmpfilter** parameter specifies the number of an IGMP filter to apply to the port. An IGMP filter controls the multicast groups that the port can be a member of by filtering IGMP Membership Reports from hosts attached to the port. If you specify a filter number, an IGMP filter with the specified number must already exist. You can apply an IGMP filter to more than one switch port, but a single port can have only one filter assigned to it. Specify **none** to apply no filter to the port, or to remove an existing filter from the port. The default is **none**.

The new **igmpmaxgroup** parameter specifies the maximum number of multicast groups that the port can join. Specify **none** to set no limit. The default is **none**.

For trunk ports, the value of **igmpaction**, **igmpfilter**, and **igmpmaxgroup** for the master port will apply to the trunk.

Example To apply IGMP filter 1 to port 12, use the command:

```
set swi po=12 igmpfi=1
```

To limit the number of multicast groups that ports 12–23 can join to 50, use the command:

```
set swi po=12-23 igmpma=50
```

show igmp filter

Syntax `SHow IGMP FILter[=filter-id]`

where:

- *filter-id* is a decimal number in the range 1 to 99.

Description This command displays information about an IGMP filter or all IGMP filters (Figure 9, Table 12). If a **filter** is specified, only information about that filter is displayed.

Figure 9: Example output from the show igmpfilter command

```
IGMP Filters
-------------------------------------------------------------------
No.  Entry  Group Address                    Action        Matches
-------------------------------------------------------------------
1    -      -                                -                  -

  Received: 230          Passed: 200          Dropped: 30
-------------------------------------------------------------------
99   224    224.1.2.3       224.1.2.3        Exclude            10
     229    229.1.1.1       229.2.2.2        Include             8

  Received: 80           Passed: 70           Dropped: 10
-------------------------------------------------------------------
```

Table 12: Parameters in the output of the **show igmp filter** command

Parameter	Meaning
No.	The filter number.
Entry	The entry number of an entry in this filter.
Group Address	The multicast group address range for this entry.
Action	The action to take when the group address of an IGMP Membership Report matches this entry's group address.
Matches	The number of IGMP Membership Reports matched by this entry.
Received	The number of IGMP Membership Reports received on the switch port that this filter is attached to.
Passed	The number of IGMP Membership Reports included and forwarded to IGMP for processing by this filter.
Dropped	The number of IGMP Membership Reports excluded and discarded by this filter.

Examples To display information about IGMP filter 3, use the command:

```
sh igmp fil=3
```

show igmpsnooping

Syntax `SHow IGMPSNooping [VLAN={`*`vlan-name`*`|1..4094}]`

where *vlan-name* is a unique name for the VLAN 1 to 32 characters long. Valid characters are uppercase and lowercase letters, digits, the underscore, and the hyphen.

Description The output of this command includes a new field (Figure 10, Table 13).

Figure 10: Example output from the **show igmpsnooping** command

```
IGMP Snooping
------------------------------------------------------------------------------
Status ........................... Enabled
Disabled All-groups ports ........ (list)

Vlan Name (vlan id) ..... default (1)
Fast Leave ............... On
Group List ..............

  Group. 225.1.2.3                          Entry timeout 268 secs
  Ports  16,19

  Group. 239.1.2.3                          Entry timeout 180 secs
  Ports  21

Vlan Name (vlan id) ..... vlan2 (2)
Fast Leave ............... On
Group List ..............

  All Groups                                Entry timeout 255 secs
  Ports  13


Vlan Name (vlan id) ..... vlan3 (3)
Fast Leave ............... Off
Group List ..............

  No group memberships.

------------------------------------------------------------------------------
```

Table 13: New parameter in output of the **show igmpsnooping** command

Parameter	Meaning
Fast Leave	Whether Fast Leave processing is enabled on this VLAN.

show switch port

Syntax `SHow SWItch POrt[={`*port-list*`|ALL}]`

where *port-list* is a port number, range (specified as *n-m*), or comma-separated list of numbers and/or ranges. Port numbers start at 1 and end at *m*, where *m* is the highest numbered Ethernet port.

Description The output of this command includes a new field (Figure 11, Table 14).

The output shown is for AR400 and AR700 routers.

Figure 11: Example output from the **show switch port** command

```
 Switch Port Information
-------------------------------------------------------------
Port ............................. 1
  Description .................... To intranet hub, port 4
  Status ......................... ENABLED
  Link State ..................... Up
  UpTime ......................... 00:10:49
  Configured speed/duplex ........ Autonegotiate
  Actual speed/duplex ............ 100 Mbps, full duplex
  Automatic MDI/MDI-X ............ Enabled
  Configured MDI/MDI-X............ MDI-X
  Actual MDI/MDI-X................ MDI
  Broadcast rate limit ........... 128Kbps
  Multicast rate limit ........... -
  DLF rate limit ................. -
  Flow control ................... Disabled
  Send tagged pkts for VLAN(s) ... vlan2 (2)
                                   vlan3 (3)
  Port-based VLAN ................ accounting (4)
  Ingress Filtering .............. OFF
  IGMP Filter .................... None
  Max-groups/Joined .............. Undefined/0
  IGMP Max-groups Action ......... Deny
-------------------------------------------------------------
```

Table 14: New parameters in the output of the **show switch port** command

Parameter	Meaning
IGMP Filter	The IGMP filter applied to the port, or "None" if an IGMP filter has not been set.
Max-groups/Joined	The maximum number of multicast groups the port can join, or "Undefined" if a limit has not been set, and the number of multicast groups that the port is currently a member of.
IGMP Max-groups Action	The action to take when the port attempts to join more multicast groups than the maximum allowed; one of "Deny" or "Replace".

OSPF Network Types

OSPF treats the networks attached to OSPF interfaces as one of the following network types, depending on the physical media:

- broadcast
- non-broadcast multi-access (NBMA)
- point-to-point
- point-to-multipoint
- virtual

By default, Ethernet and VLAN networks are treated as broadcast networks. You can configure an Ethernet or VLAN interface as either a broadcast or an NBMA network. Configure an Ethernet or VLAN interface as an NBMA interface when:

- some devices on the network do not support multicast addressing
- you want to select which devices on the network are to become OSPF neighbours, rather than allow all the devices on the network to become OSPF neighbours

Configuring the network type

To add an Ethernet or VLAN interface to OSPF as a broadcast network (the default), use the command:

```
add ospf interface=interface [other-options...]
```

To add an Ethernet or VLAN interface to OSPF and set the network type to NBMA, use the command:

```
add ospf interface=interface network=non-broadcast
    [other-options...]
```

To change the network type of an existing Ethernet or VLAN interface, use the command:

```
set ospf interface=interface
    network={broadcast|non-broadcast} [other-options...]
```

To display the network type of an OSPF interface, use the command:

```
show ospf interface=interface full
```

To display the network types of all OSPF interfaces, use the command:

```
show ospf interface full
```

Neighbours on non-broadcast networks

When you change the network type of an Ethernet or VLAN interface from broadcast to non-broadcast:

- All OSPF packets are sent as unicast messages, not broadcast messages, so neighbours need to be statically configured.
- Any existing dynamically learned neighbours are automatically converted to static neighbours, and will appear in any configuration script created by using the **create config** command.
- Hello messages are not transmitted until at least one static neighbour exists.

You can add, delete or modify static neighbours by using the commands:

```
add ospf neighbour=ipadd priority=0..255
delete ospf neighbour=ipadd
set ospf neighbour=ipadd
```

You can display the list of currently configured static neighbours using the command:

```
show ospf neighbour
```

You can configure the time interval between hello messages sent to neighbours that are deemed to be inactive. To do this, use the **pollinterval** parameter on the **add ospf interface** and **set ospf interface** commands.

Neighbours on broadcast networks

When you change the network type of an Ethernet or VLAN interface from non-broadcast to broadcast:

- Any existing statically defined neighbours are cleared.
- Hello messages are sent as broadcast messages, so neighbours are dynamically learned.

You can display the list of current neighbours using the command:

```
show ospf neighbour
```

Command Changes

The following table summarises the new and modified commands (see **Command Reference Updates**).

Command	Change
add ospf interface	New **network** parameter
set ospf interface	New **network** parameter
show ospf interface	Existing **Type** field displays the current setting of the new **network** parameter

Command Reference Updates

This section describes each new command and the changed portions of modified commands and output screens. For modified commands and output, new parameters, options and fields are shown in bold.

add ospf interface

Syntax

```
ADD OSPF INTerface=interface AREa={BAckbone|area-number}
   [AUthentication={AREadefault|NONE|PASSword|MD5}]
   [BOOST1=0..1023] [DEadinterval=2..2147483647]
   [DEMand={ON|OFF|YES|NO|True|False}]
   [HEllointerval=1..65535]
   [NETwork={BROadcast|NON-broadcast}]
   [PASSIve={ON|OFF|YES|NO|True|False}]
   [PASSword=password] [POLLInterval=1..2147483647]
   [PRIOrity=0..255] [RXmtinterval=1..3600]
   [TRansitdelay=1..3600] [VIrtuallink=router-id]
```

Description The new **network** parameter specifies the OSPF network type of the interface, and is only valid for Ethernet or VLAN interfaces. Specify **broadcast** if you want OSPF to treat the network as a broadcast network. Hello messages are transmitted as broadcast messages, and neighbours are learned dynamically. You can not configure static neighbours or use the **pollinterval** parameter to set the time interval between hello messages to inactive neighbours. Specify **non-broadcast** if you want OSPF to treat the network as an NBMA network. All OSPF packets are transmitted as unicast messages, so neighbours must be statically defined. You can use the **pollinterval** parameter to set the time interval between hello messages to inactive neighbours. The default is **broadcast**.

set ospf interface

Syntax

```
SET OSPF INTerface=interface [AREa={BAckbone|area-number}]
   [AUthentication={AREadefault|NONE|PASSword|MD5}]
   [BOOST1=0..1023] [DEadinterval=2..2147483647]
   [DEMand={ON|OFF|YES|NO|True|False}]
   [HEllointerval=1..65535]
   [NETwork={BROadcast|NON-broadcast}]
   [PASSIve={ON|OFF|YES|NO|True|False}]
   [PASSword=password] [POLLInterval=1..2147483647]
   [PRIOrity=0..255] [RXminterval=1..3600]
   [TRansitdelay=1..3600] [VIrtuallink=router-id]
```

Description

The new **network** parameter specifies the OSPF network type of the interface, and is only valid for Ethernet or VLAN interfaces. Specify **broadcast** if you want OSPF to treat the network as a broadcast network. Hello messages are transmitted as broadcast messages, and neighbours are learned dynamically. You can not configure static neighbours or use the **pollinterval** parameter to set the time interval between hello messages to inactive neighbours. Specify **non-broadcast** if you want OSPF to treat the network as an NBMA network. All OSPF packets are transmitted as unicast messages, so neighbours must be statically defined. You can use the **pollinterval** parameter to set the time interval between hello messages to inactive neighbours. The default is **broadcast**.

When you change the network type of an Ethernet or VLAN interface from broadcast to non-broadcast:

- All OSPF packets are sent as unicast messages, not broadcast messages, so neighbours need to be statically configured.
- Any existing dynamically learned neighbours are automatically converted to static neighbours.
- Hello messages are not transmitted until at least one static neighbour exists.

When you change the network type of an Ethernet or VLAN interface from non-broadcast to broadcast:

- Any existing statically defined neighbours are cleared.
- Hello messages are sent as broadcast messages, so neighbours are dynamically learned.

show ospf interface

Syntax

```
SHow OSPF INTerface[=interface]
   [AREa={BAckbone|area-number}] [IPaddress=ipadd]
   [{FULl|SUMmary}]
```

Description

This command displays information about OSPF interfaces. The existing **Type** field displays the configured network type.

Figure 12: Example output from **show ospf interface** command for a specified interface

```
vlan1:
  Status ..................... Enabled
  Area ....................... Backbone
  IP address ................. 192.168.250.1
  IP net mask ................ 255.255.255.0
  IP network number .......... 192.168.250.0
  Type ....................... broadcast
  OSPF on demand ............. ON (OFF)
  Passive .................... No
  State ...................... otherDR
  Router priority ............ 5
  Transit delay .............. 1 second
  Retransmit interval ........ 5 seconds
  Hello interval ............. 10 seconds
  Router dead interval ....... 40 seconds
  Poll interval .............. 120 seconds
  Interface events ........... 1
  Authentication ............. Password (area default)
  Password ................... Charlie1
  Designated router .......... 192.168.250.254
  Backup designated router ... 192.168.250.253
  Metric boost 1 ............. 0
```

Table 15: Changed parameter in the output of the **show ospf interface** command for a specific interface

Parameter	Meaning
Type	Type of network associated with the interface: Broadcast NBMA (non-broadcast multi-access) Point-to-Point Unknown Virtual

BGP Enhancements

Software Version 2.7.5 includes the following enhancements for BGP:

- **Changes to Algorithm for Determining the Best Route**
- **Automatic Summarising: Advertising as Few Routes as Possible**
- **Importing and Advertising the Default Route**

This section describes each enhancement, then the new and modified commands in **Command Reference Updates**.

Changes to Algorithm for Determining the Best Route

When multiple routes to a destination exist, BGP now uses the rules in the following table to determine which route is the best one. If a rule results in selection of a single route, the router or switch uses that route. If multiple routes still match, the router or switch goes to the next rule.

Rule	For this...	the router or switch chooses the route that...
1	local_preference	has the highest local preference. How the router or switch determines the local preference depends on the source of the route: • For routes that the router or switch learned via an EBGP session, or for routes it learned from sources such as an IGP or static configuration, the router or switch calculates the value of the preference itself. • For routes that the router or switch learned from an IBGP peer, the router or switch uses the preference supplied by the peer—the update message for that route contains a local_preference attribute indicating the degree of preference.
2	route type	came into the BGP routing table from a preferred source. The order of preference is: a. routes imported into the BGP routing table from the router or switch's RIB, using BGP import or network entries b. routes learned from an IBGP or confederation peer c. routes learned from an EBGP peer d. routes learned through a BGP aggregate entry
3	AS_path	has the shortest AS path.
4	origin	has the preferred origin. The order of preference is: a. IGP b. EGP c. INCOMPLETE
5	Multi_Exit_Discriminator value	has the lowest MED value. This rule applies if the local system is configured to take into account the value of the Multi_Exit_Discriminator (MED), and if the multiple routes are learned from the same neighbouring AS.

Rule	For this...	the router or switch chooses the route that...
6	path type	has external AS numbers in its AS path, rather than a route that has AS confederation sets or sequences in its AS path. Routes with external AS numbers are considered external paths; routes with AS confederation sets or sequences are internal paths. Note that candidate routes' AS paths only contain EBGP and confederation AS numbers, because BGP drops routes with the local AS path in their path list.
7	next_hop attribute	has the minimum cost to the next hop specified in the next_hop attribute. Deciding the cost involves looking into the IP route table.
8	router ID	it learned from the peer with the lowest router ID. The peer's router ID is determined by the following rules: • If the peer has been configured with a router ID by using the command **set bgp routerid=*ipadd***, that address is used as its router ID. • Otherwise, if a local IP address has been set for the peer, that address is used as its router ID. • Otherwise, if neither has been set, the highest IP address configured on any of the peer's interfaces is used as its router ID.
9	cluster list	has the shortest cluster list. The cluster list attribute only exists within Autonomous Systems that use route reflection, so if the router or switch's AS does not use route reflection, the cluster list is treated as having a length of zero.
10	neighbour address	it learned from the peer with the lowest neighbour IP address. The neighbour IP address is the address that the peer uses for the TCP connection that supports the peer session. For more information about the address routers or switches use, see *How to Set the IP Address that Identifies the Switch* in the BGP chapter of the Software Reference.

Command Changes

There are no command changes for this enhancement.

Automatic Summarising: Advertising as Few Routes as Possible

Problem When BGP learns routes, it imports and advertises every route, even if some are routes to subnets of the same network. For example, if you used the subnets 192.168.1.64/26 and 192.168.1.128/26, BGP would advertise routes to both of these. Depending on the router or switch's role in your network, this may be undesirable because it:

- exposes network topology
- creates more update messages than necessary
- increases the size of the routing table

Solution With Software Version 2.7.5, there are two available solutions:

- The new automatic summarising feature, which enables BGP to automatically summarise all locally-originated prefixes into their class A, B or C networks. This option allows BGP to summarise prefixes when it imports OSPF, RIP, interface and statically-configured routes.

  Automatic Summarising describes this new feature.

- The existing route aggregation feature, which is useful when you want to summarise subnet routes that are within particular class A, B or C networks. This option allows BGP to summarise subnets from any source, including from BGP peers.

  Route aggregation is an existing feature, but we have improved the Software Reference's description of it. **Aggregating Routes** contains the new description.

Automatic Summarising

About automatic summarising When BGP imports routes from another routing source, such as OSPF, by default it stores and advertises every route, no matter how specific. If your LAN is divided into subnets, this means BGP advertises a route to each subnet. You can avoid this by enabling automatic summarising. This feature summarises prefixes into networks and only advertises a route to that network. It is particularly useful on the external speaker for an AS—the router or switch that links an internal network to a public network.

When you enable automatic summarising, the router or switch summarises subnets into their Class A, B or C network. Instead of writing the route to the subnet into the BGP routing table and advertising that subnet route, it writes a single route to the summary network. For example, instead of storing and advertising routes to 192.168.1.64/26 and 192.168.1.128/26, BGP would have one route to 192.168.1.0/24.

Caution Only turn on automatic summarising if you own the whole classful network for your locally-generated routes. Otherwise, you advertise yourself as the next hop for subnets that you do not own.
For example, if you owned 202.202.202.0/24, you could use automatic summarising. However, if you only owned 202.202.202.64/26, you must not use automatic summarising.

Configuring automatic summarising

If you want to import routes from RIB into BGP and automatically summarise them into networks, use the following procedure. Instead of importing routes to subnets within each network, BGP then imports and advertises the route to the summary network. It specifies this router or switch as the next hop for the summary route.

Step	Command	Action
1	add bgp import={interface|ospf|rip|static} [routemap=*routemap*] or add bgp network=*prefix*[/0..32] [mask=*mask*] [routemap=*routemap*]	Turn on importing for the required routing source or network. Note that automatic summarising applies to all routes that BGP imports. If you configure multiple import or network entries, BGP summarises routes from all of them.
2	**enable bgp autosummary**	Enable automatic summarising.
3	show bgp route	Check that BGP has imported and summarised the desired networks.

Examples of automatic summarising

The following table uses the example of the static routes 192.168.1.64/26 and 192.168.1.128/26 to show what BGP advertises with different combinations of import and network entries, with and without automatic summarising.

Automatic summarising?	Commands	BGP advertises
No	add bgp import=static add ip route=192.168.1.64/26 nexthop=*ipadd* add ip route=192.168.1.128/26 nexthop=*ipadd*	Routes to 192.168.1.64/26 and 192.168.1.128/26.
	add bgp network=192.168.1.0/24 add ip route=192.168.1.64/26 nexthop=*ipadd* add ip route=192.168.1.128/26 nexthop=*ipadd*	Nothing. BGP does not advertise a route to 192.168.1.0/24 unless it can find one in the router or switch's RIB.
	add bgp import=static add bgp network=192.168.1.0/24 add ip route=192.168.1.64/26 nexthop=*ipadd* add ip route=192.168.1.128/26 nexthop=*ipadd*	Routes to 192.168.1.64/26 and 192.168.1.128/26. BGP does not advertise a route to 192.168.1.0/24 unless it can find one in the router or switch's RIB.
Yes	add bgp import=static enable bgp autosummary add ip route=192.168.1.64/26 nexthop=*ipadd* add ip route=192.168.1.128/26 nexthop=*ipadd*	A single route to 192.168.1.0/24 with nexthop=0.0.0.0. Automatic summarising replaces the two subnet entries in the BGP routing table with this one entry.
	add bgp network=192.168.1.0/24 enable bgp autosummary add ip route=192.168.1.64/26 nexthop=*ipadd* add ip route=192.168.1.128/26 nexthop=*ipadd*	A single route to 192.168.1.0/24 with nexthop=0.0.0.0. BGP advertises 192.168.1.0/24 because it finds a route to that network in the router or switch's RIB.
	add bgp import=static add bgp network=192.168.1.0/24 enable bgp autosummary add ip route=192.168.1.64/26 nexthop=*ipadd* add ip route=192.168.1.128/26 nexthop=*ipadd*	A single route to 192.168.1.0/24 with nexthop=0.0.0.0. You do not need to specify both import and network entries.

Aggregating Routes

About route aggregation

When BGP receives routes from its peers or imports them from the RIB, by default it advertises every route, no matter how specific. You can reduce the number of routes BGP advertises, by configuring aggregate prefix entries. If the router or switch receives a route to a subset of the entry's prefix, BGP adds the aggregate prefix to its database, as well as the route for the more specific prefix. You can set the router or switch to advertise only the aggregate.

Consider a configuration in which you create an aggregate entry of 192.168.1.0/24 and set the aggregate entry to advertise only the aggregate. If the router or switch receives routes to the prefixes 192.168.1.64/26 and 192.168.1.128/26, it stores all three prefixes but only advertises 192.168.1.0/24.

Note that the router or switch does not use the aggregate route for IP routing. The router or switch only uses the aggregate to determine which routes to advertise.

The router or switch advertises the aggregate route as coming from the router or switch's autonomous system, and sets the aggregate's atomic_aggregate attribute.

Caution Make sure that you own all the IP addresses in the aggregate entry. Otherwise, you advertise yourself as the next hop to addresses that you do not own.
For example, if you own 202.202.202.0/24, you can configure that as an aggregate entry. However, if you only own 202.202.202.64/26, you must not configure an aggregate of 202.202.202.0/24.

Configuring route aggregation

To aggregate subnets and only advertise the aggregate prefix, use the command:

```
add bgp aggregate=prefix[/0..32] [mask=mask] summary=yes
    [routemap=routemap]
```

The **aggregate** parameter specifies the network that BGP aggregates subnets into.

The **summary** parameter controls advertisement. If this parameter is **yes**, the router or switch only advertises the route to the aggregate. Note that unadvertised routes are still displayed in output of the **show bgp route** command, but are marked with an "s".

Creating an aggregate entry does not immediately add the aggregate prefix to the BGP routing table. BGP adds the aggregate prefix when it receives an advertisement of a more specific subnet.

Command Changes

The following table summarises the new and modified commands for automatic summarising (see **Command Reference Updates**).

Command	Change
enable bgp autosummary	New command
disable bgp autosummary	New command
show bgp	New **Auto summary** field

Importing and Advertising the Default Route

Software Version 2.7.5 enables you to control whether:

- BGP imports the default route (0.0.0.0/0) from the router or switch RIB into the BGP routing table

  To configure this feature, use the new commands:

  ```
  enable bgp defaultoriginate
  ```

  ```
  disable bgp defaultoriginate
  ```

- BGP advertises the default route to its peers

  To configure this feature, use the new **defaultoriginate** parameter in the commands:

  ```
  add bgp peer
  ```

  ```
  set bgp peer
  ```

Command Changes

The following table summarises the new and modified commands (see **Command Reference Updates**).

Command	Change
Importing the default route into BGP	
enable bgp defaultoriginate	New command
disable bgp defaultoriginate	New command
show bgp	New **Default route origination** field
Advertising the default route to a BGP peer	
add bgp peer	New **defaultoriginate** parameter
set bgp peer	New **defaultoriginate** parameter
show bgp peer	New **Default originate** field

Command Reference Updates

This section describes each new command and the changed portions of modified commands and output screens. For modified commands and output, new parameters, options and fields are shown in bold.

add bgp peer

Syntax

```
ADD BGP PEer=ipadd REMoteas=1..65534
    [DEFaultoriginate={NO|YES}] [other-options...]
```

Description

The new **defaultoriginate** parameter specifies whether to advertise the default route (0.0.0.0/0) to this peer, when the router or switch's BGP routing table contains the default route. To advertise the default route, you need to do all of the following:

- set this parameter to **yes**
- create the default route on the router or switch (or the router or switch needs to learn it from another routing source)
- configure BGP with an import or network entry that includes the default route
- import the default route into the BGP routing table, by using the **enable bgp defaultoriginate** command on page 54

The default is **no**. Therefore, by default the router or switch does not propagate the default route from its BGP routing table to the peer's RIB.

disable bgp autosummary

Syntax

```
DISable BGP AUTOSUmmary
```

Description

This command stops the router or switch from automatically summarising locally originated or imported subnet routes into a single route.

Automatic summary is disabled by default.

Example

To disable automatic summary, use the command:

```
dis bgp autosu
```

disable bgp defaultoriginate

Syntax `DISable BGP DEFaultoriginate`

Description This command prevents BGP from importing the default route (0.0.0.0/0) into its routing table. This command over-rides other import options, so BGP does not import the default route even when it is configured with an import or network entry that includes the default route.

This feature is disabled by default. Therefore, by default BGP excludes the default route.

Example To prevent BGP from importing the default route, use the command:

```
dis bgp def
```

enable bgp autosummary

Syntax `ENAble BGP AUTOSUmmary`

Description This command enables the router or switch to automatically summarise locally originated or imported subnet routes. When automatic summarising is enabled, the router or switch summarises routes that are under the same classful network to a single route of the classful network. The router or switch imports and advertises the summary route instead. Automatic summary is disabled by default.

Example To enable automatic summary, use the command:

```
ena bgp autosu
```

enable bgp defaultoriginate

Syntax `ENAble BGP DEFaultoriginate`

Description This command enables BGP to import the default route (0.0.0.0/0) into its routing table. You also need to do both of the following:

- create the default route on the router or switch (or the router or switch needs to learn it from another routing source)
- configure BGP with an import or network entry that includes the default route

This feature is disabled by default. Therefore, by default BGP excludes the default route.

To configure an import entry that includes the default route, use the **add bgp import** command and specify the default route type in the **import** parameter (most often **import=static**).

To configure a network entry that includes the default route, use the **add bgp network** command and specify **network=0.0.0.0/0**.

This command does not determine whether the router or switch advertises the default route to its BGP peers. You can configure that for each peer, by using the **defaultoriginate** parameter of the **add bgp peer** command.

Note that you do not need to enable this feature if you want to aggregate subnets of 0.0.0.0 into a single network route of 0.0.0.0/0. Instead, create an aggregate entry of 0.0.0.0/0 by using the **add bgp aggregate** command.

Example To enable BGP to import the default route, use the command:

```
ena bgp def
```

set bgp peer

Syntax `SET BGP PEer=`*`ipadd`* **`[DEFaultoriginate={NO|YES}]`**
`[`*`other-options...`*`]`

Description The new **defaultoriginate** parameter specifies whether to advertise the default route (0.0.0.0/0) to this peer when the router or switch's BGP routing table contains the default route. To advertise the default route, you need to do all of the following:

- set this parameter to **yes**
- create the default route on the router or switch (or the router or switch needs to learn it from another routing source)
- configure BGP with an import or network entry that includes the default route
- import the default route into the BGP routing table, by using the **enable bgp defaultoriginate** command on page 54

The default is **no**. Therefore, by default the router or switch does not propagate the default route from its BGP routing table to the peer's RIB.

show bgp

Syntax SHow BGP

Description The output of this command includes a new field.

Figure 13: Example output from the **show bgp** command

```
BGP router ID ................. 192.168.1.1
BGP Cluster ID ................ 192.168.1.1
Local autonomous system ....... 123
Confederation ID .............. 1234
Local preference .............. 100 (default)
Multi Exit Discriminator ...... -
Route table route map ......... -
Auto soft reconfiguration ..... Disabled
Default route origination ..... Disabled
Auto summary .................. Disabled

Number of peers
  Defined ..................... 4
  Established ................. 2
BGP route table
  Iteration ................... 231
  Number of routes ............ 12654
  Route table memory .......... 431872

BGP route flap damping ........ Enabled
```

Table 16: New parameters in the output of the **show bgp** command

Parameter	Meaning
Default route origination	Whether BGP imports the default route (0.0.0.0/0) into its routing table, when both of the following conditions occur: • the default route is present in the router or switch's RIB • BGP is configured with an import or network entry that includes the default route.
Auto summary	Whether the router or switch automatically summarises locally originated or imported subnet routes into a classful network route; one of Enabled or Disabled.

show bgp peer

Syntax SHow BGP PEer[=*ipadd*]

Description The output of this command includes a new field.

Figure 14: Example output from the **show bgp peer** command for a specific peer

```
Peer ................ 192.168.10.1
Description ......... -
State ............... Idle
Policy Template ..... 4
  Description ....... Test Template 1
Private AS filter ... Yes
Remote AS ........... 3
BGP Identifier ...... 172.20.25.2
Authentication ...... None
  Password .......... -
Fast Fall-Over ...... ENABLED
Default originate ... DISABLED
.
.
.
```

Table 17: New parameter in the output of the **show bgp peer** command for a specific peer

Parameter	Meaning
Default originate	Whether BGP advertises the default route (0.0.0.0/0) to this peer, when the router or switch's BGP routing table contains the default route.

Classifying According to the Layer 5 Byte

Software Version 2.7.5 enables you to create classifiers that match specific bytes in the Layer 5 part of IP packets. Layer 5 is the Layer 4 payload, so the new classifier parameters match parts of the TCP or UDP payload. The switch can perform its full array of hardware filtering and Quality of Service actions on matched traffic.

The flexibility of this classifier option means you can match the traffic you need to, even new protocols. You are not limited to pre-defined protocol options. This enables you to isolate new network attacks and peer-to-peer applications for network protection, monitoring and access control.

To create the classifier, use the new **l5byte** parameters in the **create classifier** or **set classifier** commands.

Command Changes

The following table summarises the modified commands (see **Command Reference Updates**).

Command	Change
create classifier	16 new **l5byte** parameters
set classifier	16 new **l5byte** parameters
show classifier	16 new **l5byte** parameters New **Layer 5 Byte** fields

Command Reference Updates

This section describes each new command and the changed portions of modified commands and output screens. For modified commands and output, new parameters, options and fields are shown in bold.

create classifier

Syntax

```
CREate CLASSifier=rule-id
   [MACSaddr={macadd|ANY}] [MACDaddr={macadd|ANY}]
   [MACType={L2Ucast|L2Mcast|L2Bcast|ANY}] [TPID=tpid|ANY]
   [VLANPriority=0..7|ANY] [VLAN={vlanname|1..4094|ANY}]
   [INNERTpid=tpid|ANY] [INNERVLANPriority=0..7|ANY]
   [INNERVLANId=VLAN=1..4094|ANY]
   [ETHFormat={802.2-Tagged|802.2-Untagged|ETHII-Tagged|
   ETHII-Untagged|NETWARERAW-Tagged|Netwareraw-untagged|
   SNAP-Tagged|SNAP-Untagged|ANY}]
   [PROTocol={protocoltype|IP|IPX|ANY}]
   [IPDScp={dscplist|ANY}] [IPTOs={0..7|ANY}]
   [IPSAddr={ipaddmask|ANY}] [IPDAddr={ipaddmask|ANY}]
   [IPPRotocol={TCP|UDP|ICMp|IGMp|ipprotocolnum|ANY}]
   [IPXDAddr={ipxadd|ANY}]
   [IPXDSocket={NCP|SAP|RIP|NNB|DIAg|NLSp|IPXwan|
   ipxsocketnum|ANY}]
   [IPXSSocket={NCP|SAP|RIP|NNB|DIAg|NLSp|IPXwan|
   ipxsocketnum|ANY}]
   [TCPSport={portid|ANY}] [TCPDport={portid|ANY}]
   [UDPSport={portid|ANY}] [UDPDport={portid|ANY}]
   [L4SMask=mask|ANY] [L4DMask=mask|ANY]
   [L5BYTE01=byteoffset,bytevalue[,bytemask]]
   [L5BYTE02=byteoffset,bytevalue[,bytemask]]
   [L5BYTE03=byteoffset,bytevalue[,bytemask]]
   [L5BYTE04=byteoffset,bytevalue[,bytemask]]
   [L5BYTE05=byteoffset,bytevalue[,bytemask]]
   [L5BYTE06=byteoffset,bytevalue[,bytemask]]
   [L5BYTE07=byteoffset,bytevalue[,bytemask]]
   [L5BYTE08=byteoffset,bytevalue[,bytemask]]
   [L5BYTE09=byteoffset,bytevalue[,bytemask]]
   [L5BYTE10=byteoffset,bytevalue[,bytemask]]
   [L5BYTE11=byteoffset,bytevalue[,bytemask]]
   [L5BYTE12=byteoffset,bytevalue[,bytemask]]
   [L5BYTE13=byteoffset,bytevalue[,bytemask]]
   [L5BYTE14=byteoffset,bytevalue[,bytemask]]
   [L5BYTE15=byteoffset,bytevalue[,bytemask]]
   [L5BYTE16=byteoffset,bytevalue[,bytemask]]
```

Description

The new **l5byte01** to **l5byte16** parameters each specify the properties of a single byte field to match in the Layer 5 part of IP packets, which is the TCP or UDP payload. For each byte field you want to match, specify:

- *byteoffset*, which is a decimal number in the range 0 to 37. This specifies the location of the byte to match. It refers to the offset from the start of Layer 5, after the UDP or TCP header
- *bytevalue*, which is a 2-digit hexadecimal number. This specifies the value of the byte at the position in the frame that is determined by *byteoffset*. The classifier matches packets that have this value at this location

- (optionally) *bytemask*, which is a 2-digit hexadecimal number. This specifies an eight-bit binary mask to apply to the field. When a bit is set to **1** in the mask, the value of the bit at the same position in the byte value is used to determine a match. A **0** in the mask means that the corresponding bit is ignored. The default is **ff**, which means the classifier matches against all bits in the byte.

Caution The classifier matches only Layer 5 bytes that are within the first 80 bytes of the IP packet. The classifier does not match against bytes that are later in the packet, even if they match the classifier's settings.
When you consider packet length, remember that the location of Layer 5 in a frame varies depending on the length of the lower-layer headers. This is because header values such as the VLAN tag can be missing, and header values such as the Ethernet format specification vary in length.

You must use **l5byte01** as the first byte field and you must number additional byte fields sequentially. Each field must have a greater offset than the fields that precede it.

The **l5byte** parameters match frames with a valid TCP or UDP header, when the network protocol is IP version 4. Therefore, **protocol** defaults to **ip** and does not need to be specified. You also do not have to specify **ipprotocol**, but by default the classifier applies to both TCP and UDP packets.

set classifier

Syntax

```
SET CLASSifier=rule-id
   [MACSaddr={macadd|ANY}] [MACDaddr={macadd|ANY}]
   [MACType={L2Ucast|L2Mcast|L2Bcast|ANY}] [TPID=tpid|ANY]
   [VLANPriority=0..7|ANY] [VLAN={vlanname|1..4094|ANY}]
   [INNERTpid=tpid|ANY] [INNERVLANPriority=0..7|ANY]
   [INNERVLANId=VLAN=1..4094|ANY]
   [ETHFormat={802.2-Tagged|802.2-Untagged|ETHII-Tagged|
   ETHII-Untagged|NETWARERAW-Tagged|Netwareraw-untagged|
   SNAP-Tagged|SNAP-Untagged|ANY}]
   [PROTocol={protocoltype|IP|IPX|ANY}]
   [IPDScp={dscplist|ANY}] [IPTOs={0..7|ANY}]
   [IPSAddr={ipaddmask|ANY}] [IPDAddr={ipaddmask|ANY}]
   [IPPRotocol={TCP|UDP|ICMp|IGMp|ipprotocolnum|ANY}]
   [IPXDAddr={ipxadd|ANY}]
   [IPXDSocket={NCP|SAP|RIP|NNB|DIAg|NLSp|IPXwan|
   ipxsocketnum|ANY}]
   [IPXSSocket={NCP|SAP|RIP|NNB|DIAg|NLSp|IPXwan|
   ipxsocketnum|ANY}]
   [TCPSport={portid|ANY}] [TCPDport={portid|ANY}]
   [UDPSport={portid|ANY}] [UDPDport={portid|ANY}]
   [L4SMask=mask|ANY] [L4DMask=mask|ANY]
   [L5BYTE01=byteoffset,bytevalue[,bytemask]]
   [L5BYTE02=byteoffset,bytevalue[,bytemask]]
   [L5BYTE03=byteoffset,bytevalue[,bytemask]]
   [L5BYTE04=byteoffset,bytevalue[,bytemask]]
   [L5BYTE05=byteoffset,bytevalue[,bytemask]]
   [L5BYTE06=byteoffset,bytevalue[,bytemask]]
```

```
[L5BYTE07=byteoffset,bytevalue[,bytemask]]
[L5BYTE08=byteoffset,bytevalue[,bytemask]]
[L5BYTE09=byteoffset,bytevalue[,bytemask]]
[L5BYTE10=byteoffset,bytevalue[,bytemask]]
[L5BYTE11=byteoffset,bytevalue[,bytemask]]
[L5BYTE12=byteoffset,bytevalue[,bytemask]]
[L5BYTE13=byteoffset,bytevalue[,bytemask]]
[L5BYTE14=byteoffset,bytevalue[,bytemask]]
[L5BYTE15=byteoffset,bytevalue[,bytemask]]
[L5BYTE16=byteoffset,bytevalue[,bytemask]]
```

Description The new **l5byte01** to **l5byte16** parameters each specify the properties of a single byte field to match in the Layer 5 part of IP packets, which is the TCP or UDP payload. For each byte field you want to match, specify:

- *byteoffset*, which is a decimal number in the range 0 to 37. This specifies the location of the byte to match. It refers to the offset from the start of Layer 5, after the UDP or TCP header.
- *bytevalue*, which is a 2-digit hexadecimal number. This specifies the value of the byte at the position in the frame that is determined by *byteoffset*. The classifier matches packets that have this value at this location
- (optionally) *bytemask*, which is a 2-digit hexadecimal number. This specifies an eight-bit binary mask to apply to the field. When a bit is set to **1** in the mask, the value of the bit at the same position in the byte value is used to determine a match. A **0** in the mask means that the corresponding bit is ignored. The default is **ff**, which means the classifier matches against all bits in the byte.

Caution The classifier matches only Layer 5 bytes that are within the first 80 bytes of the IP packet. The classifier does not match against bytes that are later in the packet, even if they match the classifier's settings.
When you consider packet length, remember that the location of Layer 5 in a frame varies depending on the length of the lower-layer headers. This is because header values such as the VLAN tag can be missing, and header values such as the Ethernet format specification vary in length.

You must use **l5byte01** as the first byte field and you must number additional byte fields sequentially. Each field must have a greater offset than the fields that precede it.

The **l5byte** parameters match frames with a valid TCP or UDP header, when the network protocol is IP version 4. Therefore, **protocol** defaults to **ip** and does not need to be specified. You also do not have to specify **ipprotocol**, but by default the classifier applies to both TCP and UDP packets.

show classifier

Syntax

```
SHow CLASSifier[={rule-id|ALL}] [MACSaddr={macadd|ANY}]
   [MACDaddr={macadd|ANY}]
   [MACType={L2Ucast|L2Mcast|L2Bcast|ANY}] [TPID=tpid|ANY]
   [VLANPriority=0..7|ANY] [VLAN={vlanname|1..4094|ANY}]
   [INNERTpid=tpid|ANY] [INNERVLANPriority=0..7|ANY]
   [INNERVLANId=VLAN=1..4094|ANY]
   [ETHFormat={802.2-Tagged|802.2-Untagged|ETHII-Tagged|
   ETHII-Untagged|NETWARERAW-Tagged|Netwareraw-untagged|
   SNAP-Tagged|SNAP-Untagged|ANY}]
   [PROTocol={protocoltype|IP|IPV6|IPX|ANY}]
   [IPDScp={dscplist|ANY}] [IPTOs={0..7|ANY}]
   [IPSAddr={ipaddmask|ipv6-add/prefix-length|ANY}]
   [IPDAddr={ipaddmask|ipv6-add/prefix-length|ANY}]
   [IPPRotocol={TCP|UDP|ICMp|IGMp|ipprotocolnum|ANY}]
   [IPXDAddr={ipxadd|ANY}]
   [IPXDSocket={NCP|SAP|RIP|NNB|DIAg|NLSp|IPXwan|
   ipxsocketnum|ANY}]
   [IPXSSocket={NCP|SAP|RIP|NNB|DIAg|NLSp|IPXwan|
   ipxsocketnum|ANY}]
   [TCPSport={portid|ANY}] [TCPDport={portid|ANY}]
   [UDPSport={portid|ANY}] [UDPDport={portid|ANY}]
   [L4SMask=mask|ANY] [L4DMask=mask|ANY]
   [L5BYTE01=byteoffset,bytevalue[,bytemask]]
   [L5BYTE02=byteoffset,bytevalue[,bytemask]]
   [L5BYTE03=byteoffset,bytevalue[,bytemask]]
   [L5BYTE04=byteoffset,bytevalue[,bytemask]]
   [L5BYTE05=byteoffset,bytevalue[,bytemask]]
   [L5BYTE06=byteoffset,bytevalue[,bytemask]]
   [L5BYTE07=byteoffset,bytevalue[,bytemask]]
   [L5BYTE08=byteoffset,bytevalue[,bytemask]]
   [L5BYTE09=byteoffset,bytevalue[,bytemask]]
   [L5BYTE10=byteoffset,bytevalue[,bytemask]]
   [L5BYTE11=byteoffset,bytevalue[,bytemask]]
   [L5BYTE12=byteoffset,bytevalue[,bytemask]]
   [L5BYTE13=byteoffset,bytevalue[,bytemask]]
   [L5BYTE14=byteoffset,bytevalue[,bytemask]]
   [L5BYTE15=byteoffset,bytevalue[,bytemask]]
   [L5BYTE16=byteoffset,bytevalue[,bytemask]]
```

Description This command displays information about classifiers. If you specify any of the new **l5byte01** to **l5byte16** parameters, the switch only displays classifiers that match that parameter.

Figure 15: Example output from the **show classifier** command (layer 5 byte data)

```
Classifier Rules
-----------------------------------------------------------------
 Rule ................. 1
  S-IP Address ......... ANY
  D-IP Address ......... ANY
  IP Protocol .......... ANY
  TOS/DSCP ............. ANY
  Layer 5 Byte 01:
    Offset ............. 0
    Value .............. 50
  Layer 5 Byte 02:
    Offset ............. 1
    Value .............. 4f
  Layer 5 Byte 03:
    Offset ............. 2
    Value .............. 53
  Layer 5 Byte 04:
    Offset ............. 3
    Value .............. 54
    Mask ............... fc
-----------------------------------------------------------------
```

Table 18: New parameters in the output of the **show classifier** command (layer 5 byte data)

Parameter	Meaning
Layer 5 Byte 01 to Layer 5 Byte 16	Each Layer 5 Byte field specifies the properties of a single byte field to match in the Layer 5 part of IP packets, which is the TCP or UDP payload.
Offset	The offset of a byte from the start of Layer 5. This specifies the location of the byte to match.
Value	The hexadecimal value to match at the location specified by Offset
Mask	A hexadecimal number that specifies an eight-bit binary mask to apply to the value before determining a match. A 1 in the mask means that the value of the bit in that position is used to determine a match, and a 0 means that the bit is ignored.

Firewall Enhancements

Software Version 2.7.5 includes the following enhancements to the firewall:

- **Increased Number of Firewall Policy Rules**
- **SIP Application Layer Gateway Diagnostic Tools**
- **UDP Port Timeout**

This section describes each enhancement, then the new and modified commands in **Command Reference Updates**.

Increased Number of Firewall Policy Rules

Software Version 2.7.5 enables you to associate up to 699 rules with each interface in a firewall policy. To associate rules with a firewall policy, use the existing command:

```
add firewall policy=policy-name rule=rule-id
   action={allow|deny|nat|nonat} interface=interface
   protocol={protocol|all|egp|gre|icmp|ospf|sa|tcp|udp}
   [other-options...]
```

Command Changes

There are no command changes for this enhancement.

SIP Application Layer Gateway Diagnostic Tools

Debugging

With Software Version 2.7.5, the command syntax for specifying SIP Application Layer Gateway (ALG) debugging has changed, and you can debug traffic to and from particular IP addresses. To enable SIP ALG debugging, use the command:

```
enable firewall policy[=policy-name] debug=sipalg
   [debugmode={all|errorcode|message|parsing|trace}]
   [ip=ipadd[-ipadd]]
```

To disable SIP ALG debugging, use the command:

```
disable firewall policy[=policy-name] debug=sipalg
   [debugmode={all|errorcode|message|parsing|trace}]
   [ip=ipadd[-ipadd]]
```

To see the debugging settings, use the command:

```
show firewall policy[=policy-name]
```

Logging

Software Version 2.7.5 enables the firewall to create SIP ALG log messages for a wide variety of actions, ranging from normal operation to error conditions. To collect log messages, first configure the logging module. Then enable the firewall to create SIP ALG log messages, by using the command:

```
enable firewall policy[=policy-name] log=sipalg
   [other-options...]
```

To disable SIP ALG logging, use the command:

```
disable firewall policy[=policy-name] log=sipalg
   [other-options...]
```

To see the logging settings, use the command:

```
show firewall policy[=policy-name]
```

Displaying Sessions

Software Version 2.7.5 enables you to limit information displayed about firewall sessions to only the sessions that are associated with a particular IP address or range of addresses. To do this, use the command:

```
show firewall session[=session-number] ip=ipadd[-ipadd]
   [other-options...]
```

Command Changes

The following table summarises the modified commands (see **Command Reference Updates**).

Command	Change
Debugging	
enable firewall policy debug	New **sipalg** option for **debug** parameter New **debugmode** parameter New **ip** parameter
disable firewall policy debug	New **sipalg** option for **debug** parameter New **debugmode** parameter
show firewall policy	Existing **Enabled Debug Options** field displays SIPALG when SIP ALG debugging is enabled New **Enabled Debug Modes** field New **Debug IP Address** field
Logging	
enable firewall policy	New **sipalg** option for **log** parameter
disable firewall policy	New **sipalg** option for **log** parameter
show firewall policy	Existing **Enabled Logging Options** field displays SIPALG when SIPALG logging is enabled
Displaying Sessions	
show firewall session	New **ip** parameter

UDP Port Timeout

Existing software versions allow you to configure a specific amount of time, per firewall policy, for which the firewall maintains inactive UDP sessions. This amount of time is called the UDP timeout, and is configured with the **udptimeout** parameter in the **set firewall policy** command.

As well as this firewall UDP timeout, you can now configure a UDP port timeout value per server port. For configured UDP ports only, the UDP port timeout value overrides the general UDP timeout configured for the firewall.

A list of UDP ports can be specified for each firewall policy, and each port can have a different UDP timeout value.

To add a UDP timeout to a specific UDP port or group of ports, use the command:

```
add firewall policy udpporttimeout=port-number
```

To modify a UDP timeout for a specific UDP port or group of ports, use the command:

```
set firewall policy udpporttimeout=port-number
```

To delete a UDP timeout from a specific UDP port or group of ports, use the command:

```
delete firewall policy udpporttimeout=port-number
```

To view the UDP port timeout settings that are configured for a firewall policy, use the command:

```
show firewall policy udpporttimeout
```

Command changes

The following table summarises the new commands (see **Command Reference Updates**).

Command	Change
add firewall policy udpporttimeout	New command
delete firewall policy udpporttimeout	New command
set firewall policy udpporttimeout	New command
show firewall policy udpporttimeout	New command

Command Reference Updates

This section describes each new command and the changed portions of modified commands and output screens. For modified commands and output, new parameters, options and fields are shown in bold.

add firewall policy udpporttimeout

Syntax

```
ADD FIREwall POLIcy=policy-name UDPPorttimeout=port
   [TIMeout={0..43200|DEFault}]
```

where:

- *policy-name* is a character string 1 to 15 characters long. Valid characters are uppercase and lowercase letters, digits, and the underscore character.
- *port* is a UDP port number or a list of comma-separated UDP port numbers from 1 to 65535.

Description

This command assigns a UDP port timeout value to a UDP server port, or group of ports, on the specified policy. For the specified port only, the UDP port timeout value overrides the UDP timeout that is defined with the **set firewall policy** command.

The UDP port timeout is applied to all UDP sessions that use the specified server port. The switch ends any inactive sessions on the port when the defined UDP port timeout period expires.

The **udpporttimeout** parameter specifies the port to assign the UDP port timeout value to.

The **timeout** parameter specifies the timeout period for the port in minutes. If you specify **0**, the timeout period is set to 30 seconds. If you specify no value or **default**, then the policy's UDP timeout configured is used. To set the policy's UDP timeout, use the **set firewall policy udptimeout** command.

Example

To add a timeout of 25 minutes for all UDP sessions using UDP port 5060, to the policy 'zone1', use the command:

```
add fire poli=zone1 udpp=5060 tim=25
```

delete firewall policy udpporttimeout

Syntax `DELete FIREwall POLIcy=`*`policy-name`* `UDPPorttimeout=`*`port`*

where:

- *policy-name* is a character string 1 to 15 characters long. Valid characters are uppercase and lowercase letters, digits, and the underscore character.
- *port* is a UDP port number or a list of comma-separated UDP port numbers from 1 to 65535.

Description This command deletes a previously defined UDP port timeout from the specified port. The UDP timeout defined with the **set firewall policy** command is once again used for the port.

The **udpporttimeout** parameter specifies the port to delete the previously defined UDP port timeout from.

Example To delete the UDP port timeout for port 5060 on the policy 'zone 1', use the command:

```
del fire poli=zone1 udpp=5060
```

disable firewall policy

Syntax

```
DISable FIREwall POLIcy=name [ACCcouting]
   [FRAgment={ICMP|UDP|OTHER}[,...]]
   [ICMP_Forwarding={ALL|PARAmeter|PING|SOURcequench|TIMEE
   xceeded|TIMEStamp|UNREachable}]
   [LOG={ALLOw|DENY|DENYDump|EVERYDeny|INAIcmp|INALlow|INA
   Other|INATcp|INAUdp|INDDIcmp|INDDOther|INDDTcp|INDDUdp|
   INDDump|INDEny|INDIcmp|INDOther|INDTcp|INDUdp|OUTAIcmp|
   OUTAllow|OUTAOther|OUTATcp|OUTAUdp|OUTDDIcmp|OUTDDOther
   |OUTDDTcp|OUTDDUdp|OUTDDump|OUTDEny|OUTDIcmp|OUTDOther|
   OUTDTcp|OUTDUdp|SIPAlg}]
   [OPtions={ALL|RECord_route|SECUrity|SOURcerouting|TIMES
   tamp}] [PING]
```

where *policy-name* is a string 1 to 15 characters long. Valid characters are uppercase and lowercase letters, digits, and the underscore character.

Description The new **sipalg** option on the **log** parameter stops the firewall from producing log messages when SIP ALG operations and errors occur.

disable firewall policy debug

Syntax

```
DISable FIREwall POLIcy[=policy-name]
   DEBug={ALL|ARP|HTTP|PACKET|PKT|PROCESS|PROXY|SMTP|
   RADius|TCP|UPNP|SIPAlg}
   [DEBUGMode={ALL|ERRORcode|MESSage|PARSing|TRAce}]
```

Description

The new **sipalg** option on the **debug** parameter specifies that SIP ALG debugging is disabled.

The new **debugmode** parameter specifies one or more modes of SIP ALG debugging to be disabled. You can specify a single mode or a comma-separated list of modes. See Table 19 on page 69 for a description of each option. This parameter is only valid when **debug=sipalg**. The default is **all**.

Examples

To stop displaying how the firewall modifies SIP messages processed by the *voip* policy, use the command:

```
dis fire poli=voip deb=sipa debugm=pars
```

enable firewall policy

Syntax

```
ENAble FIREwall POLIcy=policy-name [ACCounting]
   [FRAgment={ICMP|UDP|OTHER}[,...]]
   [ICMP_Forwarding={ALL|PARAmeter|PING|SOURcequench|TIMEE
   xceeded|TIMEStamp|UNREachable}]
   [LOG={ALLOw|DENY|DENYDump|EVERYDeny|INAIcmp|INALlow|
   INAOther|INATcp|INAUdp|INDDIcmp|INDDOther|INDDTcp|
   INDDUdp|INDDump|INDEny|INDIcmp|INDOther|INDTcp|INDUdp|
   OUTAIcmp|OUTAllow|OUTAOther|OUTATcp|OUTAUdp|OUTDDIcmp|
   OUTDDOther|OUTDDTcp|OUTDDUdp|OUTDDump|OUTDEny|OUTDIcmp|
   OUTDOther|OUTDTcp|OUTDUdp|SIPAlg}]
   [OPtions={ALL|RECord_route|SECUrity|SOURcerouting|TIMES
   tamp}] [PING]
```

where *policy-name* is a string 1 to 15 characters long. Valid characters are uppercase and lowercase letters, digits and the underscore character.

Description

The new **sipalg** option on the **log** parameter enables the firewall to produce log messages when SIP ALG operations and errors occur.

enable firewall policy debug

Syntax

```
ENAble FIREwall POLIcy[=policy-name]
   DEBug={ALL|ARP|HTTP|PACKET|PKT|PROCESS|PROXY|SMTP|
   RADius|TCP|UPNP|SIPAlg}
   [DEBUGMode={ALL|ERRORcode|MESSage|PARSing|TRAce}]
   [IP=ipadd[-ipadd]]
```

where:

- *ipadd* is an IP address in dotted decimal notation

Description

The new **sipalg** option on the **debug** parameter displays information about the SIP application layer gateway and packets it processes.

The new **debugmode** parameter specifies the types of debugging information to be enabled (Table 19). You can specify a single mode or a comma-separated list of modes. This parameter is only valid when **debug=sipalg**. The default is **errorcode** + **message** + **parsing**.

Table 19: SIP ALG debugging mode options

Option	Result
ALL	Enables all SIP ALG debugging mode options.
ERRORcode	Translates internal SIP ALG error codes into meaningful messages, displaying any errors encountered during processing.
MESSage	Translates each SIP message that is passed to the SIP ALG and displays its contents line by line. The contents of a SIP message include a SIP header and may include a Session Description Protocol (SDP) message body. Each message is displayed first in its unmodified state as it arrives for processing by the SIP ALG, then in its modified state after processing.
PARSing	Displays the steps the firewall takes during the parsing of a SIP message (header and body) while they are occurring. This includes showing how the message is modified to facilitate communication across the firewall.
TRAce	Displays the names of all the functions that the SIP ALG calls when it processes a SIP message.

The **ip** parameter specifies an IP address or a range of addresses, and is valid when **debug=sipalg**. If you specify **ip**, the firewall only displays debugging messages for packets whose IP address matches the specified address. The firewall matches the specified IP address against the source and destination addresses of packets on both the private and public interfaces. By default, the firewall displays debugging messages for all IP addresses.

Examples

To see how the firewall modifies SIP messages processed by the *voip* policy, use the command:

```
ena fire poli=voip deb=sipa debugm=pars
```

set firewall policy udpporttimeout

Syntax

```
SET FIREwall POLIcy=policy-name UDPPorttimeout=port
   TIMeout={0..43200|DEFault}
```

where:

- *policy-name* is a character string 1 to 15 characters long. Valid characters are uppercase and lowercase letters, digits, and the underscore character.
- *port* is a UDP port number or a list of comma-separated UDP port numbers from 1 to 65535.

Description

This command sets a UDP port timeout for the specified server port. You must first add a UDP port timeout to the port with the **add firewall policy udpporttimeout** command.

The UDP port timeout is applied to all UDP sessions that use the specified port. Any inactive sessions on the port are ended when the defined UDP port timeout period expires.

The **udpporttimeout** parameter specifies the port to assign the UDP port timeout to.

The **timeout** parameter specifies the timeout period for the port in minutes. If **0** is specified, the timeout period is set to 30 seconds. If **default** is specified, then the UDP timeout configured for the policy with the **set firewall policy** command is used.

Example

To set a udp port timeout of 30 minutes for UDP port 5060, for the policy 'zone1', use the command:

```
set fire poli=zone1 udpp=5060 tim=30
```

show firewall policy

Syntax `SHow FIREwall POLIcy[=`*`policy-name`*`] [COUnter] [SUMmary]`

where:

- *policy-name* is a string 1 to 15 characters long. Valid characters are uppercase and lowercase letters, digits, and the underscore character.

Description This command displays detailed information about the specified policy or all policies.

Figure 16: Example output from the **show firewall policy** command

```
Policy : Office
  TCP Timeout (s) ..................... 3600
  UDP Timeout (s) ..................... 1200
  Other Timeout (s) ................... 1200
  TCP Handshake Timeout Mode ........ Normal
  MAC Cache Timeout (m) ............... 1440
  RADIUS Limit ....................... 100
  Accounting ......................... disabled
  Enabled Logging Options ........... none
  Enabled Debug Options ............. none
  Enabled Debug Modes ............... none
  Enabled Debug IP Address .......... none
.
.
.
```

Table 20: New parameters in the output of the **show firewall policy** command

Parameter	Meaning
Enabled Logging Options	The logging options that are currently enabled. If SIP ALG logging is enabled, this field displays "SIPALG". If no options are enabled, "none" is displayed.
Enabled Debug Options	The debugging options that are currently enabled. If SIP ALG debugging is enabled, this field displays "SIPALG". If no options are enabled, "none" is displayed.
Enabled Debug Modes	The debug modes that are currently enabled, if SIP ALG debugging is enabled; one or more of ALL, ERRORCODE, MESSAGE, PARSING and TRACE. For a description of the available debugging options, see Table 19 on page 69. If SIP ALG debugging is disabled, "none" is displayed.
Enabled Debug IP Address	A single IP address or IP address range. If SIP ALG debugging is enabled, the firewall only displays debugging messages for packets whose IP address matches this address. If the firewall displays debugging messages for all IP addresses, "all" is displayed. If SIP ALG debugging is disabled, "none" is displayed.

show firewall policy udpporttimeout

Syntax `SHow FIREwall POLIcy[=`*`policy-name`*`] UDPPorttimeout`

where:

- *policy-name* is a character string 1 to 15 characters long. Valid characters are uppercase and lowercase letters, digits, and the underscore character.

Description This command displays information about any UDP ports on the firewall that are explicitly set with a UDP port timeout.

Figure 17: Example output from the **show firewall policy udpporttimeout** command

```
Policy : test
 Default UDP Timeout (s) : 1200
 Number of Configured UDP Port Timeouts : 5

UDP Port          Timeout (s)
--------------------------------
    5000            1800
    5060            1800
    6000             300
    7000            2400
    8000         default
--------------------------------
```

Table 21: Parameters in output of the **show firewall policy udpporttimeout** command

Parameter	Meaning
Policy	The name of a policy.
Default UDP Timeout (s)	The length of time, in seconds, for which the firewall policy maintains inactive UDP sessions.This is also the amount of time, in seconds, for which UDP ports with a configured UDP port **timeout** of **default** remain inactive before the session times out.
Number of Configured UDP Port Timeouts	The number of ports in this policy that have a specific UDP port timeout value configured.
UDP Port	The UDP port numbers for which a specific UDP port timeout value is configured.
Timeout (s)	The amount of time, in seconds, for which UDP ports with a specific UDP port timeout may remain inactive before the session times out. If **default** is displayed, the port is using the Default UDP Timeout.

show firewall session

Syntax

```
SHow FIREwall SEssion[=session-number]
   [POLIcy=policy-name] [COUnter] [IP=ipadd[-ipadd]]
   [POrt={port[-port]|service-name}]
   [PROTocol={protocol|ALL|EGP|GRE|ICmp|OSPF|TCP|UDP}]
   [SUMmary] [UPNP]
```

where:

- *ipadd* is an IP address in dotted decimal notation

Description

This command displays information about the sessions and flows currently active for the specified policy.

The new **ip** parameter specifies an IP address or a range of addresses. If you specify **ip**, sessions that involve that IP address are displayed. The firewall matches the specified IP address against the source and destination addresses of packets on both the private and public interfaces.

WAN Load Balancing

WAN load balancing enables you to distribute your router's wide area traffic across two or more of its ports. Software Version 2.7.5 provides support for WAN load balancing on AR400 series routers.

A range of traffic balancing distribution methods are provided. Basic load balancer distribution methods are:

- round robin distribution
- weighted lottery distribution

On both AR400 and AR700 series routers, Software Version 2.7.5 extends the available distribution methods to include the following:

- weighted fast response distribution
- weighted least connect distribution

This software version also provides healthcheck network monitoring to remote hosts. You can employ healthcheck monitoring either to simply open or close network paths, depending on their host's reachability status, or you can use the healthcheck response times to adaptively balance the traffic sent through each of the router's ports.

For information about WAN load balancing, its commands, and how to configure it, see the WAN Load Balancing chapter at the end of this Release Note.

VRRP Preemption Delay

Preemption delay support is an enhancement to the Virtual Router Redundancy Protocol (VRRP) that lets you specify a time delay between one router or switch assuming control from another one.

The effect of this enhancement is that it is now possible to specify a delay between the time the higher-priority device becomes available, and the time it assumes mastership.

VRRP specifies the method of how a backup assumes control when the master fails. Each router or switch is assigned a priority within the redundancy group. The preferred master is the router or switch that owns the virtual router address and has the highest priority.

When a master becomes unavailable, the backup routers or switches participate in an election process. The device with the highest priority becomes the new master.

If the preemption feature is enabled, then whenever a device within the group with a higher priority than the current master becomes available, it automatically assumes the master role. If preemption is disabled, only the preferred master takes control from the current master when it is available.

Command Changes

The following table summarises the modified commands (see **Command Reference Updates**).

Command	Change
create vrrp	new **delay** parameter
set vrrp	new **delay** parameter
show vrrp	new **Preempt Mode Delay (seconds)** field

Command Reference Updates

This section describes each new command and the changed portions of modified commands and output screens. For modified commands and output, new parameters, options and fields are shown in bold.

create vrrp

Syntax

```
CREate VRRP=vr-identifier OVER=physical-interface
   IPaddress=ipadd [ADINTerval=1..255]
   [ADOPTvrip={ON|OFF}]
   [ADVertisements={ON|OFF|YES|NO|TRUE|FALSE}]
   [AUTHentication={NONE|PLAINtext}] [PASSword=password]
   [PORTMOnitoring={ON|OFF}
   [STEPVALue={stepvalue|PRoportional}]]
   [PREEmpt={ON|OFF}] [DELay=0..3600] [PRIOrity=1..254]
```

Description

This command creates a VRRP virtual router with a specific identifier (VRID).

The new **delay** parameter specifies the number of seconds that a higher priority device must wait before preempting a lower priority device. It allows a delay of up to one hour (3600 seconds). This parameter is valid only when the **preempt** parameter is **on**.

After a device determines it has the highest priority, it waits the delay time, and then assumes control. A delay can ensure that there is adequate time for the master to update its routing tables before taking over. The default is **0** or off.

We recommend that all devices participating in the same virtual router be configured with the same **delay** value. This should be the case if all switches have an equal amount of routing information to update before becoming the new master. Command checking does not enforce this because it cannot determine the values of delays set on other switches. In some cases it may be valid to have different values on different devices; doing so does not affect the delay function as long as the value covers the “worst case” time required to fully update routing tables.

The existing **preempt** parameter specifies whether a higher priority router or switch preempts a lower priority router or switch acting as the master. If **on**, preempt mode is used. The default is **on**. If this parameter is **off**, preemption cannot occur; any preemptions in progress are cancelled immediately.

The preferred master (with a priority of 255) always assumes the master role when it is available, regardless of the setting of this parameter. Note that all routers or switches in the same virtual router must be configured with the same value for this parameter. The default is **on**.

set vrrp

Syntax

```
SET VRRP=vr-identifier [ADINTerval=1..255]
   [ADOPTvrip={ON|OFF}]
   [ADVertisements={ON|OFF|YES|NO|TRUE|FALSE}]
   [AUTHentication={NONE|PLAINtext}] [PASSword=password]
   [PORTMOnitoring={ON|OFF}
   [STEPVALue={stepvalue|PRoportional}]]
   [PREEmpt={ON|OFF}] [DELay=0..3600] [PRIOrity=1..254]
```

Description

The new **delay** parameter specifies the number of seconds that a higher priority switch must wait before preempting a lower priority switch. The **delay** parameter is valid only when the **preempt** parameter is **on**. The parameter allows a delay of up to one hour (3600 seconds).

After the switch determines it has the highest priority, it waits the delay time, and then assumes control. A delay can ensure that there is adequate time for the master to update its routing tables before taking over. The default is **0** or off.

We recommend that all switches participating in the same virtual router be configured with the same **delay** value. This should be the case if all switches have an equal amount of routing information to update before becoming the new master. Command checking does not enforce this because it cannot determine the values of delays set on other switches. In some cases it may be valid to have different values on different devices, and doing so does not affect the delay function as long as the value covers the "worst case" time required to fully update routing tables.

The pre-existing **preempt** parameter specifies whether a higher priority router or switch preempts a lower priority router or switch acting as the master. If **on**, preempt mode is used. The default is **on**. If this parameter is **off**, preemption cannot occur; if any preemptions are in progress, they are immediately cancelled.

The preferred master (with a priority of 255) always assumes the master role when it is available, regardless of how the **preempt** parameter is set. Note that all routers or switches participating in the same virtual router must be configured with the same value for this parameter.

show vrrp

Syntax SHow VRRP[=*vr-identifier*]

Description This command displays information about the specified virtual router or all the virtual routers in which the router or switch is participating.

Figure 18: Example output from the **show vrrp** command

```
Virtual Router Identifier ............. 1

 Configuration:
  VR MAC ADDRESS ..................... 00-00-5E-00-01-01
  Interface .......................... ppp0
  Priority ........................... 255
  State .............................. INITIAL
  Authentication ..................... None
  Password ........................... NOT SET
  IP Address(es) ..................... 202.36.163.156
  Advertisements ..................... ON
  Advertisement Interval ............. 1
  Preempt Mode ....................... ON
  Preempt Mode Delay (seconds)....... 60
  Port Monitoring .................... ON
  Step value ......................... 40
.
.
.
```

Table 22: New parameters in output of the **show vrrp** command

Parameter	Meaning
Preempt Mode Delay (seconds)	Period in seconds that the router or switch delays before assuming the master role after it has determined that its priority is greater than all other routers or switches. Valid only when preempt mode is on.

Chapter 1

WAN Load Balancing

Introduction

This chapter describes the WAN load balancing feature, how it is supported on the router, and how you can configure its operation.

With the increasing use of the Internet to service core business functions comes the need for reliable WAN connectivity. A specific aspect of this requirement is the need for reliable connectivity to specific destinations. This requirement can be simply and effectively met by providing alternative network connections via different Internet service providers (ISPs). In this way an outage limited to one ISP will not result in a loss of connectivity to remote destinations, providing these are still accessible via the other ISP.

Tip For information about other methods of load balancing, see the Server Load Balancing chapter of your router's Software Reference.

Operating Principles

When a WAN load balancing router simultaneously connects to multiple WAN networks, it will try to distribute its traffic equally across each network interface. A typical example is a router that has two Internet connections, each exchanging data to remote sites via different Internet service providers (ISPs). In this case you can configure the load balancer to balance its traffic based either on the traffic profile to each port's ISP, or to specific remote destinations.

Although connectivity via multiple WAN interfaces can be achieved using routing protocols such as RIP and OSPF; these protocols usually choose their routing paths based on routing metrics rather than on dynamic load conditions. For example, if a router has two WAN ports and each port connects to a different ISP, the router will send most of its traffic via the port offering the best metric. Although this method provides alternative connectivity in the event of an ISP network failure, under normal operating conditions it wastes the bandwidth available via the alternative port.

When a router receives a packet from one of its interfaces, it creates an IP session (termed a *flow*) based on the following fields:

- source and destination IP addresses
- upper layer protocol used.

When WAN load balancing is enabled, the router creates each load balancer session based the particular combination of values contained within these fields. Each field combination is represented by a particular *IP flow*. The router then creates a mapping between the particular IP flow and its load balancer session. The IP flows and the load balancer sessions have a many-to-one relationship. This means many IP flows can be mapped onto a single load balancer session. Once the load balancer has applied its algorithm to determine the best balanced route to use, it remembers this route for future traffic. Therefore IP flows that share the same LB session will use the same route for forwarding.

When WAN load balancing is disabled, the router uses its existing routing protocols and tables to determine the path for a particular IP flow and will also remember this route for future packets that belong to the same flow.

In order to efficiently operate with applications that can simultaneously run multiple applications, the WAN load balancer is able to create sessions without the need to specify port information.

The load balancer manages its sessions (creating, deleting, etc.) by starting a timer for each new session created. Each timer is refreshed when a packet for its particular session passes through the load balancer. When a particular timer reaches its **orphantimeout** value, its associated session is deemed to be orphan and is deleted.

If the load balancer is unable to find a particular resource in its tables and alternative non-load-balanced routes exist, the router will use the best alternative route available. Note that it is not mandatory for a router's WAN links to operate via the load balancer.

Load Distribution Methods

The following load distribution methods can be configured:

- **Round Robin Distribution**
- **Weighted Lottery Distribution**
- **Weighted Least Connect Distribution**
- ***Weighted Fast Response Distribution***

Round Robin Distribution

This distribution method assigns new load balancer sessions alternately to each of the WAN ports available. This distribution method is simple to implement and is light on processing resources. However, round robin takes no account of factors such as the bandwidth of each WAN connection, as does the weighted lottery distribution method, which is described next.

Weighted Lottery Distribution

This distribution method assigns load balancer sessions to WAN ports by using a pseudo-random selection process. Each WAN port is assigned a weighting factor that increases or decreases the chances of the pseudo-random selection process selecting a particular port. Weighting factors can be set either manually or automatically.

When configuring the WAN load balancer manually, we recommend setting the weighting factor equal to the bandwidth of the link divided by a factor such as 1000. Therefore, a 10 Mbps link would be assigned a weighting factor of 10000000 ÷ 1000 = 10000.

The higher the weighting factor that is applied to a port, the greater will be its chances of being selected.

For example, if a router has two ports A and B, and:

- port A is configured with a weighting factor of 1000
- port B is configured with a weighting factor of 2000.

then the load balancer is twice as likely to select port B than port A. However, if both ports are assigned the same weighting factor then the selection process resorts to the round robin selection method.

Weighted Least Connect Distribution

This distribution method assigns new load balancer sessions to WAN ports based on the current load (in sessions) on each WAN port. The load on a port is determined by dividing the number of its current sessions, by its weighted value. The WAN load balancer selects the WAN port with the smallest load, or more precisely, the port with the least connections relative to its weighting. To simplify configuration, *weighted least connect* uses the inverse of these values then selects the port with the *highest* numeric value. This is explained in the following example.

If a router has two ports A and B, and:

- port A is configured with a weighting factor of 4000 and has 10 current WAN load balancer sessions
- port B is configured with a weighting factor of 2000 and has 4 current WAN load balancer sessions

then the weighted least connect for port A will be, 4000 ÷ 10 = 400, and the weighted least connect for port B will be 2000 ÷ 4 = 500.

In this case, the load balancer will select port B next because it has the higher weighted least connect value.

Because the weighted least connect method is based on dynamic information, it offers a slight advantage over the static ratio assignment method used by the weighted lottery selection. In the weighted lottery configuration, distribution of WAN load balancer sessions could become slightly unbalanced if some of the WAN ports are unavailable for selection, or if some WAN load balancer sessions persist for longer than others. By contrast, the weighted least connect configuration would maintain an even session distribution.

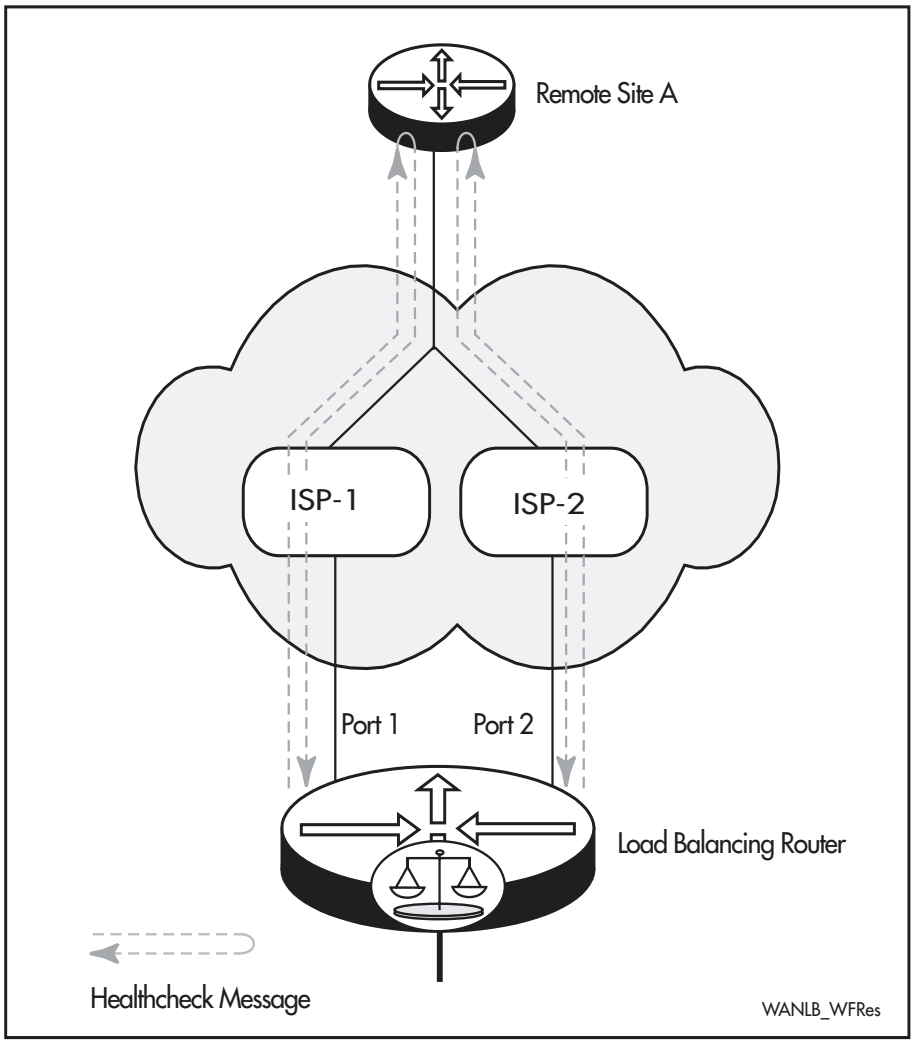
Weighted Fast Response Distribution

This distribution method assigns new load balancer sessions to WAN ports based on the response times recorded for the transmission of WAN load balancer healthcheck messages. These messages are transmitted from each of the WAN load balancer ports and record response times between these ports and selected distant hosts. WAN ports that have faster healthcheck response times will be selected more frequently than those with slower response times. This distribution method is useful when network latency is an important factor.

Note that you must configure WAN load balancer healthchecks in order to operate the weighted fast response distribution. Without healthchecks configured, the selection process will apply the equivalent of the round robin selection method.

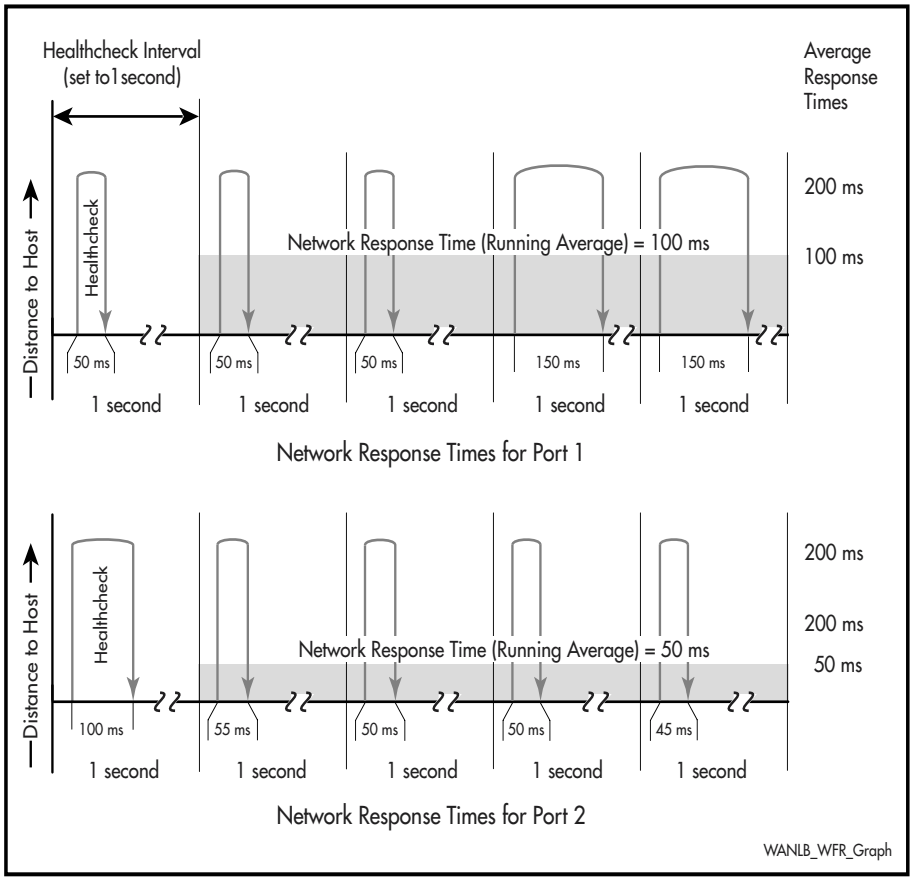
Each WAN load balancer resource maintains a moving average that covers the last four response times for each healthcheck host. From the averages received for each healthcheck host, the WAN load balancer calculates an overall average for each port.

The following figure shows a simple single host network configured for weighted fast response distribution.



The load balancer sends healthcheck messages from its ports 1 and 2, to remote site A. Although the messages from each port have a common destination, their network path and conditions are different.

The following figure shows how the round trip response times are used to determine which port the load balancer will use for its data traffic.



This figure illustrates the timing delays for a series of healthcheck messages transmitted from 2 ports on a router, where each port is sending healthchecks to a common host via its own respective network. The distance travelled by the healthchecks is indicated by the vertical arrow shown on the left-hand side of the chart, whilst their delay is measured on the horizontal time scale. An average response time, based on the last 4 healthchecks, is shown by the grey bars, which are measured by the time scale shown on the right-hand side of the chart.

The following table shows the last 4 response times recorded for each port together with their average values.

Port	Last 4 response times	Average
1	50,50,150,150	100
2	55,50,50,45	50

Because messages transmitted from port 2 have an average response that is twice as fast as those from port 1, the load balancer will select port 2 twice as often as port 1 for the data it transmits during the next healthcheck interval.

Note that because the WAN load balancer healthcheck's messages are based on ICMP packets, the response times recorded may not reflect the latency for other traffic types. Also, it is important that the sites chosen as healthcheck hosts are appropriate. For example, public servers can get overloaded with requests. Selecting these servers as healthcheck hosts could produce unrealistic results.

Assigning Weights

For weighted least connect and weighted lottery, the WAN port's assigned weight influences how often the WAN port will be selected. A good rule of thumb is to base this weight on the link's bandwidth. For situations where the underlying bandwidth of a WAN port is not known, or the bandwidth does not reflect the actual achievable throughput, WAN load balancer provides two alternatives; *Automatic*, and *Perfect Automatic*, weightings.

Automatic Weight

This method assigns a weight based on the port speed of your WAN interface. The WAN port's weight is automatically set to the speed of the link (in bits per second) divided by 1000. Therefore, a 10 Mbps link, has a weight of:

$$\frac{\text{Port Speed (bps)}}{1000} = \frac{10000000}{1000} = 10000$$

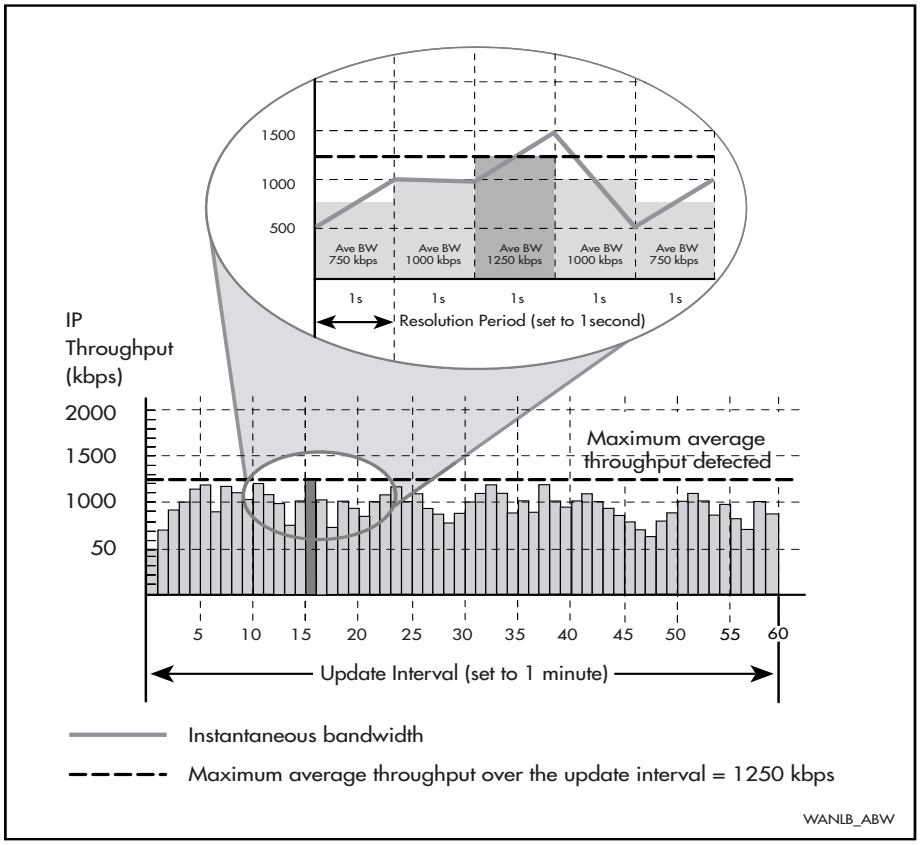
Where a port has autonegotiated its speed, the load balancer uses the negotiated speed for its weight calculation.

Where several IP interfaces use the same physical interface, the automatic weighting does not reflect the actual IP throughput that the interface is capable of. For this reason, you should not use automatic weighting with PPP links over Eth, VLAN, or L2TP interfaces.

Perfect Automatic Weight

This method assigns a weight based on throughput measurements taken by an adaptive bandwidth detection (ABD) process. ABD calculates a WAN port's available bandwidth based on the average throughput of its IP interface measured over small preset *resolution periods*. After a predefined *update interval* has expired, the ABD process records the maximum value from the individual averages observed during this interval, and uses this as the WAN port's weight for the next update interval.

The following figure illustrates the adaptive bandwidth Detection - Weight Calculation process



Healthchecks

By default, the WAN load balancer is only able to detect network malfunctions as far as the first remote connection from its wide area ports. To detect malfunctions within the wider Internet you will need to configure the WAN load balancer's healthchecks facility. By periodically sending healthcheck packets to remote hosts and monitoring their responses, the router can determine the health of selected WAN links. The WAN load balancer healthchecks can be sent from every WAN load balancer resource, to every configured host.

It is important that you give some thought to your choice of a healthcheck host and select a site that is highly reliable. The healthcheck host could be a website critical to your organisation, however, public servers can get overloaded with requests and may drop healthcheck packets.We recommend that you use Servers within a VPN network, or an intermediate node within your ISP, as your healthcheck hosts.

When healthchecks are configured, the operational state of a WAN load balancer resource is determined by the reachability of its healthcheck hosts. A WAN load balancer resource needs at least one reachable host before it can start balancing traffic. If the WAN load balancer has no reachable healthcheck hosts then the resource will no longer balance its traffic. Although you can configure healthchecks to operate with any distribution method, only the weighted fast response method applies load balancing based on network response.

To determine a host's reachability, the router sends it a series of healthcheck packets. After it receives a set number of successful responses termed *successchecks*, it considers the host to be reachable. If the router has received no replies to a defined number of healthcheck requests called *failchecks*, it considers the host to be *unreachable*.

You can configure the various healthcheck parameters by using the **set wanlb healthcheck** command on page 1-32.

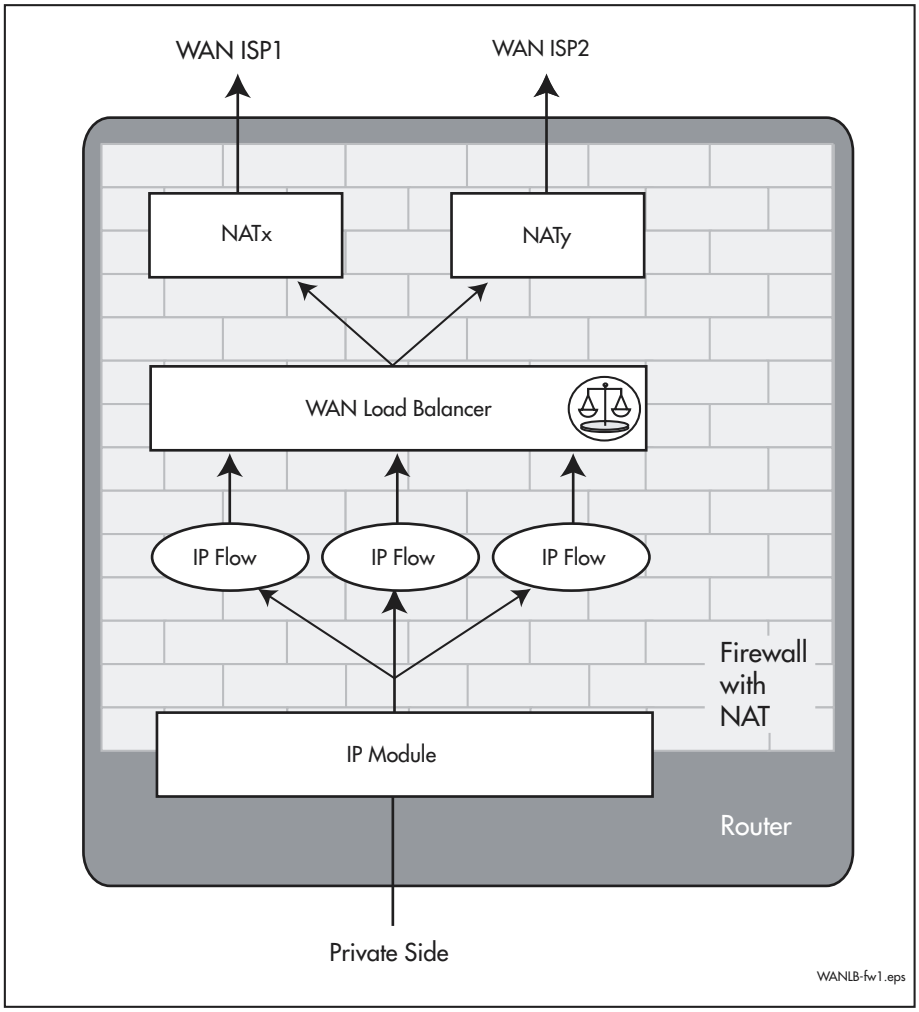
Operation with Other Software Features

This section describes how the load balancer can be used with other software features within the router.

Operation with Firewall

It is not necessary to configure the router as a firewall in order to apply WAN load balancing, although the two features have been designed to operate together and the load balancing operation will operate more effectively when used with a firewall running network address translation (NAT). The diagram shown in Figure 1-1 shows the relationship between the load balancer and the firewall functions within the router.

Figure 1-1: Example load balancer operation with firewall



The firewall shown has two public interfaces, WAN ISP1 and WAN ISP2, that are configured for both network address translation (NAT) and for WAN load balancing. Two translated IP addresses (i.e. NATx and NATy) are configured for the two WAN connections ISP1 and ISP2. When the firewall receives a packet from its private interface, it finds a route in its routing table based on the WAN load-balancing algorithm. This route determines the public interface from which it transmits the packet and which of the two addresses (NATx or NATy) it attaches as the IP source address. An important aspect is that with NAT applied, the returning packets are more likely to take the same path (via the same ISP) as the data sent and therefore offer a degree of load balancing for the return path. For more information on NAT, see *Network Address Translation* in the Firewall chapter of your router's Software Reference.

Operation with Policy Based Routing

Policy routing is an alternative mechanism for routing packets and is based on policies or rules that you or your network manager have set. Because policy routing provides *dedicated* routing, it does not participate in WAN load balancing. When a packet is received via an interface with an assigned policy filter, and the packet matches an entry in the policy filter, the routing process will bypass the WAN load balancer and forward the packet using a route with the same policy number specified in the matching policy filter entry. For more information, see Policy Based Routing in the Internet Protocol (IP) chapter of your router's Software Reference.

Operation with Priority Based Routing

Priority based routing is used in situations where you want to route a particular traffic type over paths other than those offering the best route. For example, you might want to route high priority interactive traffic over the path offering the best route, and low priority batch traffic over a path having a less efficient route.

Before the router transmits a packet via one of its interfaces, it first checks the packet for a match against the priority filter that is assigned to that particular interface. If a match is found the router assigns the packet a new priority.

The IP module places packets for forwarding in a priority queue determined by the packet's assigned priority. Packets in higher priority queues are forwarded ahead of packets in lower priority queues. Since WAN load balancing is performed before packet priority assignment, both features can work together simultaneously.

Operation with UPnP NAT Traversal

Since all UPnP related data is transmitted over a single interface, this data does not take part in load balancing. However, the UPnP feature can operate simultaneously with the WAN load balancer, although this data will add a degree of imbalance to the data distribution across the WAN load balancer interfaces.

Configuring WAN Load Balancing

This section gives a step by step procedure and simple configuration examples for configuring WAN load balancing on the router.

Before you configure

Before you configure, you need the following:

- the IP addresses of the healthcheck destination sites
- the IP addresses of the ISPs that your data will be sent to
- the network masks that you will apply for these addresses
- PPP configured, if required

How to configure the WAN Load Balancer

Table 1-1: WAN load balancing configuration procedure

Step	Commands	Description
1	enable ip	Enable the IP routing module (if it has been disabled).
2	disable ip route multipath	Because multipath IP routing and WAN load balancing have overlapping functionality, you must disable multipath routing before running the WAN load balancer.
3	add ip interface=*interface* ipaddress={*ipadd*|dhcp} [*other-options*...]	Add the logical interfaces to the IP module.
4	add ip route=*ipadd* interface=*interface* nexthop=*ipadd*[mask=*ipadd*] [*other-options*...]	Add your static routes to the IP route table. Static routes can be used to define default routes to external routers or networks.
5	add ip route=0.0.0.0 interface=*interface* nexthop=*ipadd* [*other-options*...]	Add the default routes for each interface. Default routes always have the network address 0.0.0.0. When the router receives data for which it has no route, it sends this data to the default route. To define a default route, set the IP address to 0.0.0.0 and set the nexthop address to be the network (router) that is to receive the default packets.
6	enable firewall	If firewall operation is required, enable the firewall function on the router. A log message is generated when this command is issued. Note that although the WAN load balancer will run without the firewall, we recommend that firewall NAT be used.If you are not using a firewall go to step 12 and set wanlb.
7	create firewall policy=*policy-name*	Create (and name) a firewall policy for the WAN load balancer.

Table 1-1: WAN load balancing configuration procedure (Continued)

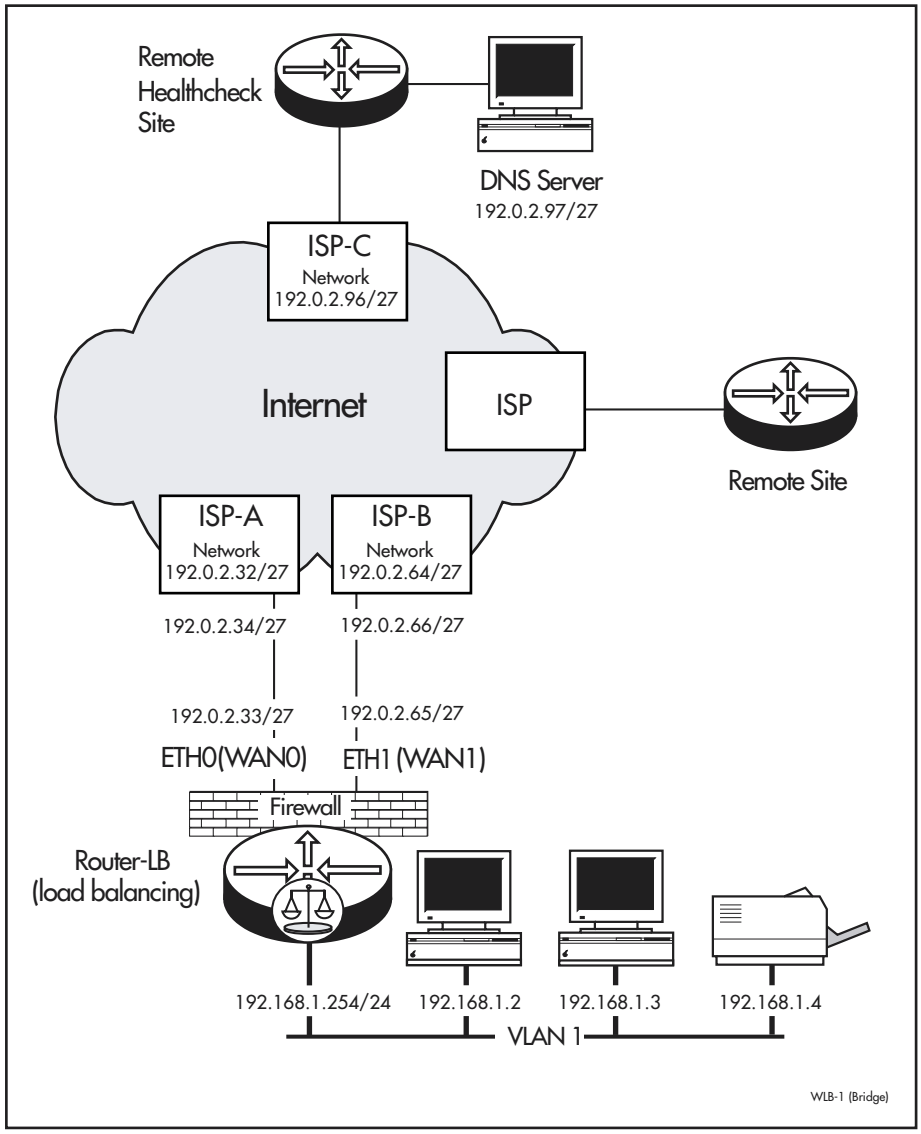
Step	Commands	Description
8	add firewall policy=*policy-name* interface=*interface* type={public|private}	Add the firewall policy to the interfaces that the load balancer will use.
9	add firewall policy=*policy-name* nat={enhanced|standard} interface=*interface* [ip=*ipadd*] gblinterface=*interface* [gblip=*ipadd*[-*ipadd*]]	Add the firewall policy for NAT and define the global IP addresses for each interface. We recommend using enhanced NAT when configuring the WAN load balancer.
10	**enable wanlb**	Enable the WAN load balancer.
11	**add wanlb resource**	Add a WAN load balancer resource to each port.
12	**set wanlb** [orphantimeout={off|1..65535}] [select={roundrobin|wleastconnect|wlottery|wfastresponse}]	Select the load balancing method you require, or keep the default settings.
13	**add wanlb resource**=*interface* [weight={0..10000000|automatic|perfectautomatic}]	If you have selected either **wleastconnect** or **wlottery**, you can select the weight options for each of the WAN load balancer interfaces. Default weight: **10000**
14	**add wanlb healthcheck** host=*hostipadd*	You can now add your remote healthcheck sites.
15	**enable wanlb healthcheck**	You can now enable healthchecking.

Configuration Examples

The following examples illustrate the steps required to configure WAN load balancing on the router.

This example shows a load balancer where data travels to remote destinations via two Internet connections, each routed via a separate ISPs. A simple firewall configuration is also included that provides for basic network address translation (NAT). This configuration will load balance data from different devices regardless of the session types that they are running, and data from the same device on a session type basis. So a data packet for an HTTP session followed by a data packet for a TFTP session transmitted from the same device would be routed via alternate ports.

Figure 1-2: Example network configuration for WAN load balancer with a single destination



To configure the WAN Balancer.

1. **Enable IP**

   To enable the IP routing module, if it has been disabled, use the command:

   ```
   enable ip
   ```

2. **Disable multipath IP route**

   To disable multipath IP routing use the command:

   ```
   disable ip route multipath
   ```

3. **Add the IP interfaces**

   To add the logical interfaces to the IP module, use the command:

   ```
   add ip interface=eth0 ip=192.0.2.32 mask=255.255.255.224
   add ip interface=eth1 ip=192.0.2.65 mask=255.255.255.224
   add ip interface=vlan1 ip=192.168.1.254 mask=255.255.255.0
   ```

4. **Add the static IP routes**

   ```
   None for this configuration
   ```

5. **Add the default IP routes**

   To add the IP routes and the next hop addresses use the command:

   ```
   add ip route=0.0.0.0 int=eth0 next=192.0.2.33
   add ip route=0.0.0.0 int=eth1 next=192.0.2.66
   ```

6. **Enable the firewall (where firewall operation is to be used)**

   ```
   enable firewall
   ```

7. **Create firewall policy**

   ```
   create firewall policy=wlb
   ```

8. **Add interfaces to the firewall policy**

   ```
   add firewall policy=wlb int=eth0 type=public
   add firewall policy=wlb int=eth1 type=public
   add firewall policy=wlb int=vlan1 type=private
   ```

9. **Configure nat**

   ```
   add firewall policy=wlb nat=enhanced interface=vlan1
      gblint=eth0
   add firewall policy=wlb nat=enhanced interface=vlan1
      gblint=eth1
   ```

10. **Enable the WAN load balancer**

    ```
    enable wanlb
    ```

11. **Add the WAN load balancer resource to each global interface**

    ```
    add wanlb resource=eth0
    add wanlb resource=eth1
    ```

12. **Set the WAN load balancer selection method**

    For round robin selection

    ```
    set wanlb select=roundrobin
    ```

For weighted least connect selection

```
set wanlb select=wleastconnect
```

For weighted lottery selection

```
set wanlb select=wlottery
```

For weighted fast response selection

```
set wanlb select=wfastresponse
```

13. Set the WAN load balancer resource weight

This step is only required if you are using weighted lottery or weighted least connect selection methods.

Using a weight value of 5000

```
set wanlb resource=eth0 weight=5000
```

For automatic weighting

```
set wanlb resource=eth0 weight=automatic
```

For perfect automatic weighting

```
set wanlb resource=eth0 weight=perfectautomatic
```

14. Add WAN load balancer healthchecks

Ignore this step if you are not using healthchecks. You will need to add healthchecks in order to use the weighted fast response distribution. You can also use healthchecks to check the connectivity between sites, and this will operate with any selection method.

In this configuration healthchecks are used to monitor the response times to a remote DNS server. These response times are used to indicate the delay through each of the ISP networks. A DNS server was chosen in this example, because DNS servers offer an *always available* service.

```
add wanlb healcheck host=192.0.2.97
```

Note that the IP address used in this example is shown for document purposes only and should not be used in a practical network.

15. Enable WAN load balancer healthchecks

```
enable wanlb healthcheck
```

Command Reference

This section describes the commands available on the router to enable, configure, control and monitor the WAN load balancing module.

The shortest valid command is denoted by capital letters in the Syntax section.

add wanlb healthcheck

Syntax `ADD WANLB HEALthcheck[=1..3] HOst=`*`hostaddress`*

Description This command adds a healthcheck host to the WAN load balancer. Up to three hosts can be added. The WAN load balancer will use these hosts for checking the status of its resources.

You can display details of the healthcheck hosts by using the **show wanlb healthcheck** command on page 1-36. To display the status of the healthcheck hosts for each resource, use the **show wanlb resource** command on page 1-37 command. To delete a host, use the **delete wanlb healthcheck** command.

Parameter	Description
1..3	Specifies the index number assigned to a host.
HOst	The *hostaddress* that will receive the WAN load balancer healthchecks. This can be either an IP address or domain name. The healthcheck responses for a host can change the operational state of the WAN load balancer resources. Also, in the weighted fast response mode, the host is used for resource selection. For this reason you should choose your host sites with care. For your healthcheck host, you could select a website critical to your organisation. However, public servers can get overloaded with requests and the response time may be less representative of the WAN link. Servers in a remote private network, or an intermediate node within your ISP, are recommended for use as healthcheck hosts. You can enter the IP address or the domain name (e.g.,www.critical-site.com) of your selected host.

Examples To add two healthcheck hosts that have the IP address 202.36.8.8 and www.vpn-site.com respectively, use the commands:

```
add wanlb heal ho=202.36.8.8
add wanlb heal ho=www.vpn-site.com
```

Related Commands
delete wanlb healthcheck
show wanlb healthcheck
show wanlb resource

add wanlb resource

Syntax

```
ADD WANLB RESource=interface [HEALthchecksipaddress=ipadd]
    [WEIght={0..10000000|AUTOmatic|PERFectautomatic}]
```

Description

This command adds a new resource to the WAN load balancer interface. By default, a newly added resource is *enabled*. The state of a new resource is the same as that of its associated IP interface. This means that the WAN load balancer interface will be available whenever the interface is available. A resource in the *up* state can participate in load balancing immediately.

Parameter	Description	
RESource	An existing IP interface for the resource. Valid interfaces are: ● eth (such as eth0, eth1) ● PPP (such as ppp0, ppp1) To see a list of current valid interfaces, use the **show interface** command. This parameter must be specified before a new resource can be created.	
HEALthchecksipaddress	The source IP address that the WAN load balancer resource uses when transmitting healthchecks to a configured host(s). If this parameter is not specified, the WAN load balancer will use the IP interface address that it has associated with the resource. This parameter is useful in VPN environments, where the healthcheck host is located in the remote private network.	
WEIght	The preference factor that the WAN load balancer will apply to a resource when creating a new WAN load balancer session. The weight of a resource is only used when the configured WAN load balancer select method is WLOTTERY (weighted lottery) or WLEASTCONNECT (weighted least connect). The higher the weight of a resource compared to the other resources, the more likely are its chances of selection for the session. Default: **10000**	
	0..10000000	The specified weight is used.
	AUTOmatic	The weight is the specified (or auto-negotiated) bandwidth of the WAN link.
	PERFectautomatic	The weight is the estimated bandwidth of the WAN link, as detected automatically through the adaptive bandwidth detection (ABD) mechanism.See the **set wanlb abd** command on page 1-30.

Examples

To add a new resource using the IP interface of PPP0 (which is configured for PPP over a 64 kbps ISDN channel) use the command:

```
add wanlb res=ppp0 wei=64
```

Related Commands

delete wanlb resource
set wanlb resource
show wanlb resource
set wanlb abd

delete wanlb healthcheck

Syntax `DELete WANLB HEALthcheck={1..3|ALL}`

Description This command removes one or more healthcheck hosts from the WAN load balancer. If all hosts are deleted, the WAN load balancer cannot use its healthchecks to determine the status of its resources. In this situation, the router will change the state of its WAN load balancer resources to be the same as their associated IP interfaces.

Parameter	Description
`1..3`	Selects a specific healthcheck host to delete.
ALL	All the healthcheck hosts will be deleted.

Examples To delete the number 2 host use the command:

```
del wanlb heal=2
```

Related Commands **add wanlb healthcheck**
show wanlb healthcheck

delete wanlb resource

Syntax `DELete WANLB RESource={ALL|`*`interface`*`}`

Description This command deletes a WAN load balancer resource. You can only delete the resource when it is in the *down* state and there are no WAN load balancer sessions assigned to it. To place the resource in the *down* state, use the **disable wanlb resource** command.

Parameter	Description
RESource	An existing IP interface for the resource. Valid interfaces are: ● eth (such as eth0, eth1) ● PPP (such as ppp0, ppp1) To see a list of current valid interfaces, use the **show interface** command. The **resource** parameter specifies the resource that is to be deleted. This resource must match an existing IP interface. If **all** is specified then all resources will be deleted.

Examples To delete the resource PPP0 use the command:

```
del wanlb res=ppp0
```

Related Commands
add wanlb resource
disable wanlb resource
enable wanlb resource
set wanlb resource
show wanlb resource

disable wanlb

Syntax `DISable WANLB`

Description This command disables WAN load balancing.

Examples To disable WAN load balancing, use the command:

```
dis wanlb
```

Related Commands
disable wanlb resource
enable wanlb
show wanlb

disable wanlb debug

Syntax

```
DISable WANLB
   DEBug[={ABD|HEALthcheck|IP|RESource|SELect|ALL}]
```

Description

This command disables debugging on the WAN load balancer.

Parameter		Description
DEBug	The type of debugging to disable. Default: **all**	
	ABD	Disables adaptive bandwidth detection debugging.
	HEALthcheck	Disables healthcheck debugging.
	IP	Disables debugging for the creation of WAN load balancer sessions for new IP flows.
	RESource	Disables debugging for WAN load balancer resource state changes.
	SELect	Disables debugging for resource selection of new WAN load balancer sessions.
	ALL	Disables all WAN load balancer debugging information.

Examples

To disable debugging on the WAN load balancer, use the command:

```
dis wanlb deb
```

Related Commands

disable wanlb debug
enable wanlb debug
show wanlb debug

disable wanlb healthcheck

Syntax `DISable WANLB HEALthcheck`

Description This command disables background healthchecking for resources. Under high load, these resources may sometimes ignore ICMP healthchecks and be marked as *closing or down* even though the resource is still operational and can take connections. After executing this command, response times for resources are set to zero. healthchecks are disabled by default.

Note that when healthchecks are disabled, the weighted-fast-response algorithm used for selecting resources operates as the round-robin algorithm. This is because all resources effectively have the same response time. Also, the states of all resources will change to the states of their associated IP interface. This is because WAN load balancer can no longer use the healthchecks to determine the states of its resources.

Examples To disable the health checking, use the command:

```
ena wanlb heal
```

Related Commands
enable wanlb healthcheck
show wanlb
show wanlb healthcheck

disable wanlb resource

Syntax `DISable WANLB RESource={ALL|`*`interface`*`} [IMMEDiately]`

Description This command disables a resource by moving it from the *up* state to the *down* state, or by moving it from the *up* state to the *closing* state and then to the *down* state. When a resource moves to the *closing* state it allows all existing sessions associated with it to complete, but the resource cannot participate in load balancing for any new sessions. Once all the sessions associated with the resource have completed, the resource is automatically moved to the *down* state.

Parameter	Description
ALL	Disables all WAN load balancer resources.
interface	The resource to be disabled. Valid interfaces are: ● eth (such as eth0, eth1) ● PPP (such as ppp0, ppp1) To see a list of current valid interfaces, use the **show interface** command. The resource name must match an enabled resource or the command will fail. If all is specified, all resources configured on the WAN load balancer will be disabled.
IMMEDiately	Moves the resource directly from the *up* state to the *down* state. If this parameter is not specified, the resource will move from the *up* to the *closing* state. A resource with no more sessions associated with it then moves to the *down* state. If this parameter is specified, all the sessions associated with the resource are deleted and the resource moves straight from the *up* state to the *down* state. Default: no default.

Examples To disable the resource interface eth0, use the command:

```
dis wanlb res=eth0
```

Related Commands

add wanlb resource
delete wanlb resource
enable wanlb resource
set wanlb resource
show wanlb resource

enable wanlb

Syntax `ENAble WANLB`

Description This command enables the WAN load balancer. Although you do not need to enable the WAN load balancer to configure its settings, you do need to enable it to run the WAN load balancing operation.

You cannot enable the WAN load balancer when equal cost multipath routing is also enabled. To disable equal cost multipath routing, use the **disable ip route** command.

Examples To enable WAN load balancer, use the command:

```
ena wanlb
```

Related Commands
disable wanlb
set wanlb
show wanlb

enable wanlb debug

Syntax

```
ENAble WANLB
   DEBug[={ALL|ABD|HEALthcheck|IP|RESource|SELect}]
```

Description This command enables debugging on the WAN load balancer.

Parameter		Description
DEBug	Enables WAN load balancer debugging	
	ABD	Displays information about Adaptive Bandwidth Detection calculations, such as the observed resource throughput and updates to the resource weight.
	HEALthcheck	Displays information about the reception and transmission of healthcheck packets, the average response time, and any changes in whether healthcheck hosts are reachable.
	IP	Displays information about the creation of new WAN load balancer sessions for new IP flows.
	RESource	Displays any state changes that occur for WAN load balancer resources.
	SELect	Displays how resource selection for new WAN load balancer sessions is determined
	ALL	Enables all types of debugging

Caution: Enabling WAN load balancer debugging may affect packet forwarding performance.

Examples To enable WAN load balancer debug, use the command:

```
ena wanlb deb
```

Related Commands

disable wanlb debug
show wanlb debug

enable wanlb healthcheck

Syntax `ENAble WANLB HEALthcheck`

Description This command enables background healthchecking for WAN load balancer resources. Background healthchecking periodically monitors the health of connections between each WAN load balancer resource and its configured healthcheck hosts. The WAN load balancer healthchecks consist of sending ICMP echo requests to the healthcheck hosts. The response time for healthchecks form the basis of the weighted fast response resource selection method.

Healthchecks are disabled by default.

Examples To enable healthchecking, use the command:

```
ena wanlb heal
```

Related Commands
add wanlb healthcheck
disable wanlb healthcheck
show wanlb

enable wanlb resource

Syntax `ENAble WANLB RESource={ALL|`*`interface`*`}`

Description This command enables a configured resource by moving it from the *down* state to the *up* state. A device must be in the *up* state to participate in WAN load balancing.

Parameter	Description
RESource	Enables the specified interfaces
interface	Specifies an existing IP interface for the resource. The resource must currently be in the *down* state before it can be enabled. If **all** is specified, all configured resources are enabled. *interface* is a valid interface name formed by concatenating an interface type and an interface instance. Valid interfaces are: ● eth (such as eth0, eth1) ● PPP (such as ppp0, ppp1) To see a list of current valid interfaces, use the **show interface** command. This parameter must be specified before a new resource can be created.

Examples To enable the resource PPP0 use the command:

```
ena wanlb res=ppp0
```

Related Commands

add wanlb resource
delete wanlb resource
disable wanlb resource
set wanlb resource
show wanlb resource

reset wanlb resource

Syntax `RESET WANLB RESource={ALL|`*`interface`*`}`

Description This command resets states of the specified wan load balancer resource. A reset is equivalent to the **disable wanlb resource** command on page 1-22, immediately followed by the **enable wanlb resource** command on page 1-26.

Parameter	Description
interface	The resource whose states are to be reset. *Interface* is a valid interface name formed by concatenating an interface type and an interface instance. Valid interfaces are: ● eth (such as eth0, eth1) ● PPP (such as ppp0, ppp1) To see a list of current valid interfaces, use the **show interface** command.
ALL	Resets the state of all wan load balancer interfaces and counters.

Examples To reset the states of all of the resources currently configured on a router, use the command:

```
reset wanlb res=all
```

Related Commands **reset wanlb resource counter**
show wanlb resource

reset wanlb resource counter

Syntax `RESET WANLB RESource={`*`interface`*`|ALL} COUnter`

Description This command resets the specified wan load balancer resource counters.

Parameter	Description
Interface	The resource whose counters are to be reset. *Interface* is a valid interface name formed by concatenating an interface type and an interface instance. Valid interfaces are: ● eth (such as eth0, eth1) ● PPP (such as ppp0, ppp1) To see a list of current valid interfaces, use the **show interface** command.
ALL	Resets the counters on all interfaces

Examples To reset the counters of all of the resources currently configured on a router, use the command:

```
reset wanlb res=all cou
```

Related Commands **reset wanlb resource**
show wanlb resource

set wanlb

Syntax

```
SET WANLB [ORPhantimeout={OFF|1..65535}]
   [SELect={ROundrobin|WLEastconnect|WLOttery|
   WFAStresponse}]
```

Description

This command sets the global parameters of WAN load balancer.

Parameter		Description
Orphantimeout	Specifies the number of seconds in which a WAN load balancer session can remain in an *orphan state* before timing out. An orphan state exists when the load balancer session is open, but neither sending nor receiving traffic. If you are using the WAN load balancer with the firewall enabled, you should either set this parameter to OFF, or set it to a value that is equal to, or greater than, the maximum timeout period of the firewall session. This is to maintain synchronisation between the WAN load balancer and firewall modules. Default: **3600**	
	OFF	Sets the *orphantimeout* parameter to never timeout.
	1..65635	Sets the *orphantimeout* period, in seconds
Select	Determines the algorithm that the WAN load balancer uses when selecting its resources (interfaces). Default: **roundrobin**	
	ROundrobin	The WAN load balancer selects each resource alternately.
	WLEastconnect	The WAN load balancer selects the resource with the highest result achieved after dividing its assigned weight by the number of its current sessions. To specify a resource's weight, use the **add wanlb resource** command on page 1-17.
	WLOttery	The WAN load balancer randomly selects a resource among its available resources. A resource with a higher weight is more likely to be selected, but if all resources have the same weight *wlottery* provides a similar result to the round *roundrobin* algorithm. To specify a resource's weight, use the **add wanlb resource** command on page 1-17 command.
	WFAStresponse	The WAN load balancer selects the resource based on the fastest response time received for resource healthchecks. For example, a resource with a response time that is twice as fast as another, will be selected twice as often.

Examples

To turn off the orphantimeout use the command:

```
set wanlb orp=off
```

Related Commands

enable wanlb
show wanlb

set wanlb abd

Syntax

```
SET WANLB ABD [RESOLution=200..5000]
   [UPDAteinterval=1..1440] [DECReasethreshold=0..75]
   [TRAFfic={TOTal|INBound|OUTBound}]
```

Description

This command sets the parameters for adaptive bandwidth detection (ABD) that are used to update the weight of resources. To apply this command you must first set the *weight* parameter of the **add wanlb resource** command on page 1-17, to *perfectautomatic*.

ABD estimates the available bandwidth for a WAN load balancer resource by observing the resource's peak throughput. The maximum detected throughput is then used as the resource's weight for the next update interval. The resource's weight for the first update interval is set to 10000 (the default resource weight). "Perfect Automatic Weight" on page 1-7.

Note that the detected bandwidth does not restrict the amount of traffic the resource is actually capable of transmitting. However, it does influence how often the resource will be selected.

Parameter	Description
RESOLution	The *resolution period*, in milliseconds, over which a resource's throughput is observed. At the end of each *resolution period* the average throughput (in kbps) is calculated for the resource based on the results obtained. The maximum value of the averages detected during an *update interval* is then used to estimate the weighting to apply for the next *update interva*l. ABD is more likely to detect a higher peak throughput for smaller *resolution periods*. However, smaller *resolution periods* may incur more CPU overhead. Default: **1000**
UPDAteinterval	The interval in minutes for updating the weight of a resource. The maximum throughput detected over the last update interval is used as the resource's weight for the next update interval. A lower update interval will mean the resource's weight will change more adaptively as the detected throughput changes. Default: **60**
DECReasethreshold	The threshold that determines whether a resource's weight should be updated if a decrease in throughput is detected. The threshold relates to the percentage decrease between the current maximum throughput detected for a resource, and its current weight (which is the maximum throughput detected for the previous update interval). If the percentage decrease is greater than the threshold, the resource's weight is not updated. If zero is specified, then the weights for resources will never decrease. Note that in addition to throughput decreasing due to problems or congestion, it can also decrease due to lack of traffic. Default: **50**

Parameter	Description	
TRAFfic	The type of traffic that will be measured in the throughput calculations. This parameter may be useful for disparities in price or speed between the upstream and downstream ISP connections. Default: **total**	
	INBound	The throughput is calculated based on inbound traffic only.
	OUTBound	The throughput is calculated based on outbound traffic only.
	TOTal	The throughput is calculated based on both inbound and outbound traffic.

Examples To change the resolution interval to 500 milliseconds use the command:

```
set wanlb abd res=500
```

Related Commands **enable wanlb**
show wanlb

set wanlb healthcheck

Syntax

```
SET WANLB HEALthcheck [INTerval=1..300] [FAILchecks=1..6]
   [SUCCesschecks=1..5]
```

Description

This command sets parameters used by the healthchecking mechanism.

Parameter	Description
INTerval	The period of time, in seconds, with which WAN load balancer regularly commences healthchecking of each resource to each healthcheck host. For example, with the default setting and two hosts, each port will check each host once every 60 seconds. Default: **60**
SUCCesschecks	The number of the consecutive successful healthchecks to a host to determine the host is reachable. Default: **2**
FAILchecks	The number of the consecutive failed healthchecks to a host to determine the host is unreachable. Default: **3**

Examples

To set the healthcheck interval to 30 seconds use the command:

```
set wanlb heal int=30
```

Related Commands

show wanlb healthcheck
enable wanlb healthcheck

set wanlb resource

Syntax

```
SET WANLB RESource=interface [HEALthchecksipaddress=ipadd]
   [WEIght={0..10000000|AUTOmatic|PERFfectautomatic}]
```

Description

This command sets the configuration of a resource. The **weight** parameter can be changed when the resource is in either the *up* or *down* state. Changes to a resource will take effect the next time the resource is used for a WAN load balancer session. Attempting to change parameters when the WAN load balancer resource is in the *closing* state will result in an error message. You can check the WAN load balancer state by using the **set wanlb resource** command on page 1-33.

Parameter	Description	
RESource	An existing IP interface for the resource. Valid interfaces are: ● eth (such as eth0, eth1) ● PPP (such as ppp0, ppp1) To see a list of current valid interfaces, use the **show interface** command. This parameter must be specified before a new resource can be created.	
HEALthchecksipaddress	The source IP address that the WAN load balancer resource uses when transmitting healthchecks to a configured host(s). If this parameter is not specified, the WAN load balancer will use the IP interface address that it has associated with the resource. This parameter is useful in VPN environments, where the healthcheck host is located in the remote private network.	
WEIght	The preference factor that the WAN load balancer will apply to a resource when creating a new WAN load balancer session. The weight of a resource is only used when the configured WAN load balancer select method is WLOTTERY (weighted lottery) or WLEASTCONNECT (weighted least connect). The higher the weight of a resource compared to the other resources, the more likely are its chances of selection for the session. Default: **10000**	
	0..10000000	The specified weight is used.
	AUTOmatic	The weight is the specified (or auto-negotiated) bandwidth of the WAN link.
	PERFectautomatic	The weight is the estimated bandwidth of the WAN link, as detected automatically through the adaptive bandwidth detection (ABD) mechanism.See the **set wanlb abd** command on page 1-30.

Examples

To set the weight of resource PPP0 when the selection method is weighted lottery, use the command:

```
set wanlb res=ppp0 weight=640
```

Related Commands

set wanlb
add wanlb resource
delete wanlb resource
set wanlb abd

show wanlb

Syntax `SHow WANLB`

Description This command displays information about the general configuration and status of the WAN load balancer (Figure 1-3, Table 1-2).

Figure 1-3: Example output from the **show wanlb** command

```
Global WAN Load Balancer Configuration
------------------------------------------------------------
Status ..................... ENABLED
Select Method ............... ROUNDROBIN
Orphan Timeout .............. 3600s
Current Sessions ............ 1
Total Resources ............. 2
Debug ....................... ENABLED
Max WANLB Sessions .......... 34952
Healthchecks ................ ENABLED
Adaptive Bandwidth Detection (ABD)
   Resolution ............... 1000 ms
   Update Interval .......... 2 minutes
   Decrease Threshold ....... 0 %
   Traffic .................. TOTAL
------------------------------------------------------------
```

Table 1-2: Parameters in the output of the **show wanlb** command

Parameter	Description
Status	Whether the WAN load balancer is enabled or disabled.
Select Method	The algorithm that the WAN load balancer is using when determining which resource to select.
Orphan Timeout	The length of time in seconds that a WAN load balancer session can exist without having any data transmitted on it. After this period, the session is declared an orphan and will close.
Current Sessions	The total number on current sessions on all resources.
Total Resources	The total number of resources configured on the WAN load balancer.
Debug	Whether debugging for the WAN load balancer is enabled or disabled.
Max WANLB Sessions	The maximum number of WAN load balancer sessions that can be created. This parameter is displayed when WAN load balancer is enabled.
Healthchecks	Indicates whether resource healthchecks are enabled or disabled.
Resolution	The duration in milliseconds used to detect the resources' weight (bandwidth).
Update Interval	The interval, in minutes, between updates to a resource's maximum weight (bandwidth) setting. This occurs only when the resource's weighting method is PERFECTAUTOMATIC.

Table 1-2: Parameters in the output of the **show wanlb** command (Continued)

Parameter	Description
Decrease Threshold	The maximum percentage that the bandwidth can decrease in one update interval and still be updated as the resource's new weight. If the maximum bandwidth detected for the last update interval has decreased beyond the threshold, then the resource's weight is not updated.
Traffic	The resource traffic that is measured by automatic bandwidth detection, one of TOTAL, INBOUND, or OUTBOUND.

Example To display the current configuration and status of WAN load balancer, use the command:

```
sh wanlb
```

Related Commands
enable wanlb debug
enable wanlb healthcheck
disable wanlb debug
set wanlb
set wanlb abd

show wanlb debug

Syntax `SHow WANLB DEBug`

Description This command lists the types of WAN load balancer debugging that are currently enabled (Figure 1-4, Table 1-3).

Figure 1-4: Example output from the **show wanlb debug** command

```
WAN Load Balancer Debug
-----------------------------------------------
Debug ....................... RESOURCE, SELECT
```

Table 1-3: Parameters in the output of the **show wanlb debug** command

Parameter	Description
Debug	The types of WAN load balancer debugging that are currently enabled; one of All, None, or a list of the enabled types.

Example To display the types of WAN load balancer debugging that are currently enabled, use the command:

```
sh wanlb deb
```

Related Commands
enable wanlb debug
disable wanlb debug

show wanlb healthcheck

Syntax `SHow WANLB HEALthcheck`

Description This command displays information about wan load balancer healthcheck resources (Figure 1-5, Table 1-4).

Figure 1-5: Example output from the **show wanlb healthcheck** command

```
WAN Load Balancer Healthcheck configuration
-----------------------------------------------------------
State ............................ ENABLED
Interval ......................... 60 seconds
Consecutive Success Checks ....... 2
Consecutive Failed Checks ........ 3

Number   Host
-----------------------------------------------------------
     1   172.20.156.100
     2   www.vpn-site.com
     3   www.critical-site.com
-----------------------------------------------------------
```

Table 1-4: Parameters in the output of the **show wanlb healthcheck** command

Parameter	Description
State	The state of the WAN load balancer healthchecks: one of enabled or disabled.
Interval	A fixed interval (in seconds) during which the WAN load balancer sends a separate healthcheck message to each of its configured hosts.
Consecutive Success Checks	The number of consecutive successful healthchecks to a specific host before it is deemed to be reachable.
Consecutive Failed Checks	The number of consecutive failed healthchecks to a host before that host is deemed unreachable.
Number	The number of the configured healthcheck host.
Host	The healthcheck host's IP address or domain name.

Example To display all parameters of healthchecks use the command:

```
sh wanlb heal
```

Related Commands **set wanlb healthcheck**

show wanlb resource

Syntax `SHow WANLB RESource[={ALL|`*interface*`}] [HEALthcheck]`

Description This command displays information about all resources for the WAN load balancer (Figure 1-6, Figure 1-7, Table 1-5). If a resource name is specified, the output displays detailed information about the particular resource (Figure 1-8 on page 1-39, Table 1-6 on page 1-40).

Parameter	Description
Resource	The resource whose information is to be displayed, where interface is a valid interface name formed by concatenating an interface type and an interface instance. Valid interfaces are: ● eth (such as eth0, eth1) ● PPP (such as ppp0, ppp1) To see a list of current valid interfaces, use the **show interface** command.
HEALthcheck	Displays detailed information about healthchecks for the specified resource (Figure 1-9 on page 1-42, Table 1-7 on page 1-42). Healthchecks are periodic checks of the health of a connection between a resource and a selected remote host. The healthcheck method involves transmitting an ICMP echo request and monitoring its response.

Figure 1-6: Example output from the **show wanlb resource** command

```
WAN Load Balancer Resources

Resource            Status              State
-----------------------------------------------------------
ppp0                DISABLED            CLOSING
eth0                ENABLED             UP
eth1                DISABLED            DOWN
-----------------------------------------------------------
```

Figure 1-7: Example output from the **show wanlb resource** command if no resources are defined

```
WAN Load Balancer Resources

Resource            Status              State
-----------------------------------------------------------
There are no resources
-----------------------------------------------------------
```

Table 1-5: Parameters in the summary output from the **show wanlb resource** command

Parameter	Description
Resource	The resource whose information is to be displayed.
Status	The current status of the resource; one of ENABLED or DISABLED.
State	The current state of the resource; one of UP, DOWN, or CLOSING. The state of a resource will have the same state as its associated IP Interface. So if the IP interface is UP, the resource state will also be UP. If the IP interface is DOWN, then the resource state will also be DOWN. If the interface is in the DISABLED state and there are still session active, then the resource state will be in the CLOSING state. Note that a resource whose healthcheck sites are all unreachable will move to the DOWN state whereupon all user data will be redirected to alternative ports. The resource will continue to issue its healthchecks and will return the UP state when the required number of **successchecks** have been received.

Figure 1-8: Example output from the **show wanlb resource=all** command

```
WAN Load Balancer Resource Configuration
-------------------------------------------------------
Resource.....................ppp0
Status.......................ENABLED
State........................UP
Weight.......................3000
Weight type .................Manual
Total Sessions ..............34123
Current Sessions.............24

Healthchecks
   Avg overall response time ....40 ms
   Resource up events .......... 1
   Resource down events ........ 0
   Unreachable host events ..... 1
   Source IP address ........... None

   Number  Avg Response   Host
   -------------------------------------------------------
        1  Unreachable    202.36.8.9
        2  20 ms          www.vpn-site.com
        3  60 ms          www.critical-site.com
   -------------------------------------------------------

-------------------------------------------------------
Resource  ..................... ppp1
Status ........................ ENABLED
State ......................... UP
Weight ........................ 3100
Weight type ................... Perfect Automatic
Total Sessions ................. 34123
Current Sessions................ 26

Adaptive Bandwidth Detection
   Current throughput .......... 3150 kbps
   Current maximum ............. 3950 bps

Healthchecks
   Avg Response ................ 30 ms
   Resource up events .......... 1
   Resource down events ........ 0
   Unreachable host events ..... 0
   Source IP address ........... 172.204.1.8

   Number  Average Response   Host
   -------------------------------------------------------
        1  20 ms          202.36.8.9
        2  20 ms          www.vpn-site.com
        3  50 ms          www.critical-site.com
   -------------------------------------------------------
```

Table 1-6: Parameters in the detailed output from the **show wanlb resource=all** command

Parameter	Description
Resource	The resource interface.
Status	The current state of the interface; on of ENABLED or DISABLED.
State	The current state of the resource; one of UP, DOWN, or CLOSING. The state of a resource will have the same state as its associated IP Interface. So if the IP interface is UP, the resource state will also be UP. If the IP interface is DOWN, then the resource state will also be DOWN. If the interface is in the DISABLED state and there are still session active, then the resource state will be in the CLOSING state.
Weight	The weight that the WAN load balancer applies to this resource when selecting resources for a session. This parameter is only used and displayed when using the weighted lottery or weighted least connect algorithms. To set the WAN load balancer algorithm, use the **set wanlb** command on page 1-29.
Weight type	How the resource weight was determined; one of Manual, Automatic, or Perfect Automatic.
Total Sessions	The total number of successful sessions that have been made to this resource while in the UP state.
Current Sessions	The total number of sessions currently running on the resource.
Adaptive Bandwidth Detection	Bandwidths calculated by adaptive bandwidth detection. These bandwidths are only displayed when the weight is determined by the PERFECTAUTOMATIC method.
Current throughput	The current throughput (in kbps) for the resource's IP interface, as calculated by adaptive bandwidth detection. It is the most most recently calculated value for the resolution period average.
Current maximum	The maximum throughput (in kbps) for the resource's IP interface, detected by adaptive bandwidth detection for the current update interval. The maximum throughput is used to update the resource's weight for the next update interval.
Healthchecks	
Avg overall response	The combined average response time from all the healthcheck host(s). This figure is displayed when the WAN load balancer uses the weighted fast response selection method. If healthchecks are disabled, the response time displayed is N/A.

Table 1-6: Parameters in the detailed output from the **show wanlb resource=all** command (Continued)

Parameter	Description
Resource Up events	The number of times the resource's state has changed from down to up due to healthchecks, i.e. because one or more hosts became *reachable*.
Resource Down Events	The number of times the resource's state has changed from up to down due to healthchecks, i.e. because all the hosts became *unreachable*.
Unreachable host events	The number of separate times a host has become 'unreachable.'
Source IP	The source IP address used for the healthcheck packets.
Number	The index number of a particular healthcheck host. These numbers are used when adding or deleting healthcheck hosts.
Average Response	The average response time in milliseconds (for the particular host) as calculated since the last healthcheck response was received, This is a moving average based on the last four response times for the particular healthcheck host. Unreachable hosts will show as unreachable.
Host	The IP address or domain name of the configured healthcheck host.

Figure 1-9: example output from the **show wanlb resource=ppp0 healthcheck** command

```
WAN Load Balancer Resource Healthchecks
-------------------------------------------------------------
Resource ..................... ppp0
Ave overall response......... 40 ms
Resource up events .......... 1
Resource down events ........ 0
Unreachable host events ..... 1
   Host ..................... 202.36.8.11
   Status ................... Unreachable
   Avg response ............. N/A
   Total sent ............... 200
   Total not sent ........... 2
   Total failed ............. 7
   Total unreachable ........ 2
   Current  successful ...... 0
   Current failed ........... 5

   Host ..................... www.vpn-site.com
   Status ................... Reachable
   Avg response ............. 20 ms
   Total sent ............... 200
   Total not sent ........... 0
   Total failed ............. 2
   Total unreachable ........ 0
   Current successful........ 198
   Current fail ............. 0

   Host ..................... www.critical-site.com
   Status ................... Reachable
   Avg response ............. 60 ms
   Total sent ............... 200
   Total not sent ........... 0
   Total failed ............. 0
   Total unreachable ........ 0
   Current  successful....... 200
   Current failed ........... 0
-------------------------------------------------------------
```

Table 1-7: Parameters in the detailed output from the **show wanlb resource=ppp0 healthcheck** command

Parameter	Description
Resource	The resource interface.
Ave overall response	The combined average response time from all the healthcheck host(s). This figure is displayed when the WAN load balancer uses the weighted fast response selection method. If healthchecks are disabled, the response time displayed is N/A.
Resource up events	The number of times the resource's state has changed from down to up due to healthchecks, i.e. because one or more hosts became reachable.
Resource down Events	The number of times the resource's state has changed from up to down due to healthchecks, i.e. because all of the hosts became unreachable.

Table 1-7: Parameters in the detailed output from the **show wanlb resource=ppp0 healthcheck** command (Continued)

Parameter	Description	
Unreachable host events	The number of separate times a host has become unreachable.	
	Host	The IP address or domain name of the configured healthcheck host.
	Status	The status of the healthcheck host for the resource; one of REACHABLE or UNREACHABLE. A host is REACHABLE when the resource has consecutively received from it the configured number **successchecks**. A host is UNREACHABLE when the resource cannot receive from it the configured number **failchecks** responses. To configure **successchecks** and **failchecks** use the **set wanlb healthcheck** command on page 1-32.
	Avg response	The average response in milliseconds from the specified host, calculated since the last healthcheck response was received, or N/A if the host is unreachable. This is a moving average based on the last four response times for a healthcheck host.
	Total sent	The total number of healthchecks sent to the host.
	Total not sent	The number of healthchecks that failed because the WAN load balancer was unable to send the healthcheck. This may occur if the IP interface is down, for example, or if a DNS lookup fails to resolve a domain name.
	Total failed	The total number of failed healthchecks.
	Total unreachable	The total number of failures that occurred while the host was unreachable. Depending on the configured number of consecutive successful responses and failures, many failures could occur without the host actually becoming unreachable.
	Current successful	The current number of consecutive successful healthchecks since the last failed response occurred.
	Current failed	The number of consecutive failed healthchecks since the last successful response occurred.

Example To display general information for all of the resources, use the command:

```
sh wanlb res
```

Related Commands

add wanlb resource
delete wanlb resource
enable wanlb resource
disable wanlb resource
set wanlb resource

show wanlb sessions

Syntax `SHow WANLB SEssions [RESource=`*`interface`*`]`

Description This command displays information about all of the sessions currently open on WAN load balancer for a specified resource, or for all resources.

The **resource** parameter specifies the interface of the resource to display sessions for. If no resource is specified, all WAN load balancer sessions are displayed. Valid interfaces are:

- eth (such as eth0, eth1)
- PPP (such as ppp0, ppp1)

To see a list of current valid interfaces, use the **show interface** command.

Figure 1-10: Example output from the **show wanlb sessions** command

```
WAN Load Balancer Sessions
Resource  Source IP         Destination IP   Prot    Expiry
-------------------------------------------------------------
ppp10
          192.168.1.1       212.72.1.246      TCP      3599
          192.168.1.2       215.73.1.33       UDP      2350
eth0
          192.168.1.10      212.72.10.246     TCP       590
          192.168.1.20      215.73.10.33      UDP      1250
-------------------------------------------------------------
```

Table 1-8: Parameters in output of the **show wanlb sessions** command

Parameter	Description
Resource	The resource whose sessions are to be displayed.
Source IP	The source IP address used for the WAN load balancer session.
Destination IP	The destination IP address for the WAN load balancer session.
Protocol	The transport protocol used for the WAN load balancer session.
Expiry	The number of seconds left before this session expires. Each time the router receives a packet, the corresponding session is refreshed and the expiry time is reset. When the time expires, the session is deleted from the session table.

Example To display all the WAN load balancer sessions, use the command:

```
sh wanlb se
```

Related Commands **show wanlb**

Chapter 2

Filtering IP Routes

Introduction

This chapter describes the router or switch's functions for filtering IP routes. IP route filtering enables you to control your routing tables, for example, to meet the terms of business relationships you have with the networks you are connected to.

If you are a network provider, you can filter the routing information that your routers or switches receive from the networks they connect to, and that they advertise to those networks. This gives you control over the path of any traffic originating from or traversing your network. Usually, one or more of your routers or switches form peer relationships with routers or switches at other ISPs with which you have entered into data transporting agreements. The process of filtering is, in effect, the process of specifying the routes that your routers or switches send or receive from each of their peers.

The router or switch provides several different mechanisms for filtering routes. Some of the functionality of these mechanisms overlaps, so sometimes you can achieve a given filtering effect in several ways. This chapter discusses all the different mechanisms and places them in context within the overall picture of how you can filter routes.

In very general terms, configuring any filter involves three steps. This chapter is divided into sections that describe each of the steps:

1. Select the required filter type, as described in **Types of Filters**.
2. Create the filter, as described in **Creating Filters**.
3. Apply it, as described in **Applying Filters**.

When to use filters

You can use route filtering to select which routes:

- the router or switch copies from a routing protocol into its Routing Information Base (RIB). This determines which routes the router or switch uses to send traffic (**Applying Filters When Writing to the RIB**).
- the router or switch copies from its RIB into a routing protocol. This determines which routes the protocol has available for advertising to neighbouring devices (**Applying Filters When Redistributing from the RIB**).
- routing protocols actually advertise to neighbouring devices (**Applying Filters Before Advertising Routes**).

The RIB is another term for the router or switch's main IP route table, which is described in *The Routing Table* in the Internet Protocol (IP) chapter of the Software Reference.

Types of routes you can filter

As explained above, this chapter first divides the information about filtering into sections about each type of filter, rather than each type of routing protocol. Then it summarises the available filters for each routing protocol, in the following sections:

- **Border Gateway Protocol (BGP-4)**
- **Open Shortest Path First (OSPF)**
- **Routing Information Protocol (RIP)**
- **Interface Routes**
- **Statically-Configured Routes**.

Types of Filters

The type of filter to use depends on the route source and the point at which you want to filter. This section describes the available filters, in the following subsections:

- **About Prefix Lists**
- **About AS Path Lists**
- **About Route Maps**
- **About IP Route Filters**
- **About IP Filters**

This section describes each of these types of filters and summarises the circumstances in which you use them.

About Prefix Lists

Description

A prefix list is a list of entries, each of which specifies:

- an IPv4 prefix, and a mask length or range of mask lengths
- whether those prefixes explicitly match or explicitly do not match the prefix list

When to use prefix lists

Prefix lists offer detailed control over which routes you import, export or advertise.

"Applying Filters" on page 2-20 describes in detail how to use prefix lists, but this section summarises the uses.

For BGP, you can use prefix lists when:

- copying routes from an update message to the RIB, by using the prefix list:
  - directly as a filter, by making it the **infilter** on a BGP peer.
  - in a route map and applying the route map as the **inroutemap** on a BGP peer
- determining which routes to import from other route sources, by using the prefix list in a route map and applying the route map to the import entry
- determining which routes to advertise, by using the prefix list:
  - directly as a filter, by making it the **outfilter** on a BGP peer
  - in a route map and applying the route map as the **outroutemap** on a BGP peer

For BGP, prefix filtering can reject some of the routes from an update message, without rejecting the whole update. This enables you to configure the router or switch to accept only routes for particular networks from a particular peer, and to send only routes for particular networks to a particular peer.

When you apply a prefix list as an **infilter** or **outfilter** on a BGP peer, BGP looks at the individual prefixes within each update message, and compares them against the list. If a prefix in the update matches a prefix in the prefix list, BGP rejects that route. Otherwise, it accepts the route.

For OSPF, you can use prefix lists in a route map, and then use the route map:

- to filter OSPF routes before adding them to the RIB
- when importing static routes into the OSPF LSA database

About AS Path Lists

Description

In BGP, the *AS_path* attribute lists the AS numbers of every Autonomous System that the routing information in an update message has passed through. It shows the path the update message has taken, and how "close" the routes are to the router or switch.

AS path lists let you filter to accept or reject update messages on the basis of all or part of their AS path. They look at the *AS_path* attribute in BGP update messages. If the attribute in the update message matches the filter criteria then the whole update message is filtered out (or accepted, depending on what action the filter entry has been configured to carry out).

When to use AS path lists

You can only use AS path lists with BGP. "Applying Filters" on page 2-20 describes in detail how to use AS path lists, but this section summarises the uses.

For BGP, you can use AS path lists when:

- copying routes from an update message to the RIB, by using the AS path list:
  - as the **inpathfilter** on a BGP peer.
  - in a route map and applying the route map as the **inroutemap** on a BGP peer
- determining which routes to advertise, by using the AS path list:
  - as the **outpathfilter** on a BGP peer
  - in a route map and applying the route map as the **outroutemap** on a BGP peer

About Route Maps

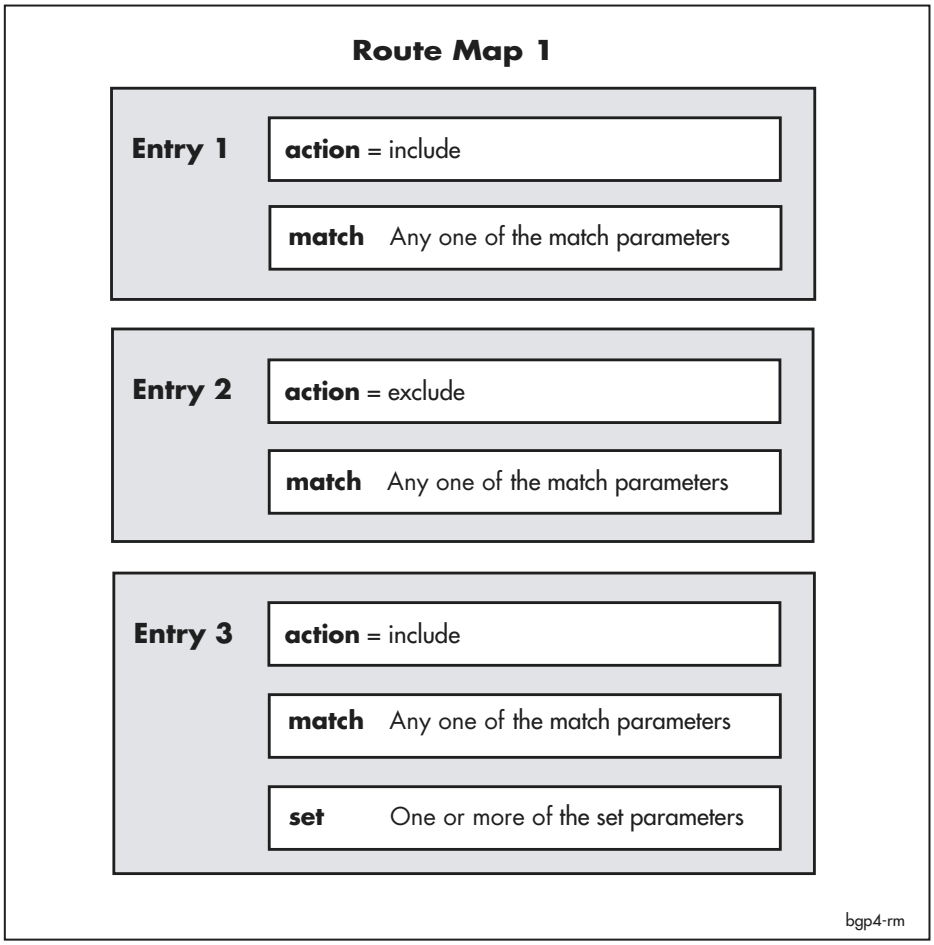
Description

Route maps are the most powerful route filtering option, and allow you to configure complex flexible filters. They achieve this by having several levels of structure:

- each route map consists of multiple entries
- each entry consists of an *action* (include or exclude) and at least one clause:
  - zero or one *match* clause, which determines which routes or BGP update messages match the entry. If you do not specify a match clause, every route or update message matches.
  - zero or more *set* clauses, which change certain features of matching routes or the attributes of matching BGP updates.

The following figure shows valid combinations of action and clause inside a route map.

Figure 2-1: Example structure of a route map



When to use route maps

"Applying Filters" on page 2-20 describes in detail how to use route maps, but this section summarises the uses.

For BGP, you can use route maps when:

- copying routes from an update message to the RIB, by applying the route map as the **inroutemap** on a BGP peer
- determining which routes to import from other route sources, by applying the route map to the import entry
- determining which routes to advertise, by applying the route map as the **outroutemap** on a BGP peer

When applied to a BGP peer, route maps can:

- accept or reject update messages on the basis of origin, community, AS path, next hop or Multi Exit Discriminator (MED)
- accept or reject particular routes, by comparing the update message's routes with a prefix list
- alter the attribute values in matching update messages.

For OSPF, you can use route maps:

- to filter routes from OSPF before adding them to the RIB
- when importing static routes into the OSPF LSA database

When applied to OSPF routes, route maps can:

- accept or reject particular routes on the basis of their metric, route type, source, nexthop or tag, or the interface they are received on
- accept or reject particular routes, by comparing the update message's routes with a prefix list
- alter matching routes' metric, type and tag.

About IP Route Filters

Description

Route filters are simple filters that examine a number of aspects of each route. When you apply filters to routing information that the router or switch receives, the filter determines whether each route is added to the RIB. When you apply filters to routing information that the router or switch transmits, the filter determines whether each route is advertised.

When to use IP route filters

"Applying Filters" on page 2-20 describes in detail how to use IP route filters, but this section summarises the uses. The main uses of IP route filters are to select:

- RIP routes when adding routes to the RIB
- RIP routes when determining which routes to advertise
- OSPF, static or interface routes when determining which routes to redistribute from the RIB into RIP
- RIP routes and OSPF summary routes when determining which routes to redistribute from the RIB into the OSPF LSA database

You can also use IP route filters to select:

- OSPF routes to add to the RIB, but we recommend you use route maps instead
- static routes to redistribute from the RIB into the OSPF LSA database, but we recommend you use route maps instead
- BGP routes to redistribute from the RIB into the OSPF LSA database, but we recommend you use IP filters with a filter number in the range 300 to 399 instead

IP route filters affect the interaction between the routing module and the RIB, but IP route filters do not filter receipt of routing protocol messages by the routing module and do not directly filter messages sent from the routing protocol. Messages sent from the routing protocol are affected if and only if they are derived from the RIB, which is true in most situations, including RIP, OSPF-ext messages, and OSPF summary Link State Advertisements (LSAs). Note that the design of OSPF prevents route filters from filtering some types of OSPF LSAs (see "Limitations of route filtering on OSPF" on page 2-31).

IP route filters do not filter BGP-derived routes, except when determining whether to add BGP routes to the OSPF LSA database. This means you cannot use IP route filters to select the routes that BGP receives, copies to the RIB, or advertises. For an overview of the filter types to use with BGP, see "Border Gateway Protocol (BGP-4)" on page 2-29.

About IP Filters

Description

An IP filter filters routes if it has a filter ID number in the range 300 to 399. It matches on the source and mask of the route, and specifies whether matching routes are included or excluded.

When to use IP filters

Use an IP filter when you want to filter routes that the router or switch imports from BGP into OSPF. "Applying Filters When Redistributing from the RIB" on page 2-23 has more information.

You can also use an IP filter as a BGP prefix filter (either an **infilter** or an **outfilter**), but we recommend you use a prefix list instead.

Creating Filters

This section describes the commands, options and procedures for creating each of the different types of filter. It contains the following subsections:

- **Creating Prefix Lists**
- **Creating AS Path Lists for BGP**
- **Creating Route Maps for BGP**
- **Creating Route Maps for OSPF**
- **Creating IP Route Filters**
- **Creating IP Filters**

Creating Prefix Lists

To create a prefix list and add entries to it, use the command:

```
add ip prefixlist=name entry=1..65535
    [action={match|nomatch}] [masklength=range] [prefix=ipadd]
```

The **masklength** parameter specifies the range of prefix mask lengths matched by this entry in the prefix list. The *range* is either a single CIDR mask from 0 to 32, or two masks separated by a hyphen. These options are valid for setting the mask length:

- As a mask length range (**masklength=*a*-*b*)**.

  For a route to match against this entry, its prefix mask length must be between *a* and *b* inclusive. *a* must be less than *b*.

- As a single mask length (**masklength=*a***).

  For a route to match against this entry, its prefix mask length must be exactly *a*.

- As an implicit mask length, by not specifying **masklength** (for example, **prefix=192.168.0.0**).

  For a route to match against this entry, its prefix mask length must correspond exactly to the mask for the class of the given address—in this example, 24.

Creating AS Path Lists for BGP

To create an AS path list and add entries to it, use one of the commands:

```
add ip aspathlist=1..99 [entry=1..4294967295]
   include=aspath-reg-exp

add ip aspathlist=1..99 [entry=1..4294967295]
   exclude=aspath-reg-exp
```

Each entry uses a regular expression, *aspath-reg-exp*, to both specify the AS numbers that the entry matches, and to establish whether matching AS numbers are included or excluded.

The following table shows regular expression syntax and examples:

Table 2-1: Syntax for AS path regular expressions

Token	Description	Examples	Meaning of example
<AS number>	Matches that identical AS number.	123	Matches any AS path attribute that contains AS 123 (but not 1234, 12345, or 5123).
^	Matches the start of the AS path attribute.	^123	Matches AS path attributes that have AS 123 as the first AS.
$	Matches the end of the AS path attribute.	^$	Matches an empty AS path attribute.
		^123$	Matches an AS path attribute with a single AS number, 123.
<space>	Separates AS numbers in a regular expression.	"123 456"	Matches AS path attributes that contain ASs 123 and 456, in that order, with no other AS numbers between them.
" "	Surrounds regular expressions that contain spaces.		
.	Matches any AS number.	.*	Matches all AS path attributes.
*	Matches zero or more repetitions of the preceding token in the AS path list being filtered.	"123 .* 456"	Matches AS path attributes that contain ASs 123 and 456, in that order, with any number of other AS numbers between them.
+	Matches one or more repetitions of the preceding token in the AS path list being filtered.	"123 .+ 456"	Matches AS path attributes that contain ASs 123 and 456, in that order, with at least one other AS number between them.

You can apply AS path lists directly to BGP peers, or use them in route maps (see "Matching on AS path list" on page 2-10).

Creating Route Maps for BGP

A route map consists of multiple entries, which are in effect individual filters. Each entry specifies both what it matches on, in a *match* clause, and what is done to matching traffic, in the entry's *action* and any *set* clauses it has.

Most set clauses modify the BGP attributes of matching update messages. If you want to change the attributes of all candidate routes, configure an entry with no match clause. Such an entry matches all update messages.

When a BGP process passes an update message through a route map:

1. It checks the entries in order, starting with the lowest numbered entry, until it finds a match.
2. It then takes the action specified by that entry's action parameter. If the action is **exclude**, it filters out that update or prefix. If the action is **include**, it filters in that update or prefix.
3. If the action is **include**, it modifies attributes as specified by the entry's set clauses if there are any.
4. It then stops processing that update message; it does not check the remaining entries in the route map.

Every route map ends with an implicit entry that matches all routes with an action of **include**. This ensures that if no entries in a route map generate a match, the update message or route is included without modification.

The rest of this section describes:

- **How to create a route map**
- **How to configure an entry with a match clause**
- **How to configure an entry with a set clause**

How to create a route map

You do not have to create a route map as a separate step—adding the first entry automatically creates it.

How to configure an entry with a match clause

The match clause for a route map entry determines which update messages or prefixes match the entry. Each entry can only match on one characteristic. Available characteristics you can use with BGP are:

- AS path list
- community list
- Multi Exit Discriminator (MED)
- next_hop attribute
- origin attribute
- prefix list
- tag

Matching on AS path list

An entry that matches on **aspath** lets you select or discard routes that have taken a particular route or routes through the network.

To do this, first create an AS path list and add entries to it by using one of the commands:

```
add ip aspathlist=1..99 [entry=1..4294967295]
    include=aspath-reg-exp

add ip aspathlist=1..99 [entry=1..4294967295]
    exclude=aspath-reg-exp
```

See "Creating AS Path Lists for BGP" on page 2-9 for more information about creating path lists. Table 2-1 on page 2-9 shows the valid syntax for the regular expression *aspath-reg-exp* and gives syntax examples.

Then use the AS path list in the match clause of a route map by using the command:

```
add ip routemap=routemap entry=1..4294967295
    [action={include|exclude}] match aspath=1..99
```

When the router or switch uses this route map to examine an update message, the router or switch goes through the entries in the AS path list. The update matches if an entry in the AS path list matches the AS path in the update message, **and** that AS path list entry is an **include** entry.

If the update message matches, the router or switch carries out the action of the route map; one of:

- exclude the update message
- include the update message without modification
- include the update message and modify its attributes

Note that the action (include/exclude) of the AS path list and the action of the route map entry are separate. The following table shows the effect of each combination.

AS path list entry	Route map entry	Action when route map applied
include	include	An update message with that AS_path matches, and is processed
include	exclude	An update message with that AS_path matches, and is discarded
exclude	include	An update message with that AS_path does not match. The router or switch continues checking to see if the update message matches other entries in the route map.
exclude	exclude	An update message with that AS_path does not match. The router or switch continues checking to see if the update message matches other entries in the route map.

In this context, the parameters **include** and **exclude** in the AS path list do not indicate whether the matching update message is allowed or dropped; they simply indicate whether the update matches or does not match the path list. This is different to the behaviour when you use the AS path list itself as a filter, as described in "Applying Filters" on page 2-20.

Example comparing AS path filter and route map

Compare this configuration, which uses an AS path list in a path filter:

```
add ip aspathlist=2 entry=1 exclude="^$"
add ip aspathlist=2 entry=2 include="15557"
set bgp peer=192.168.200.201 outpathfilter=2
```

with this configuration, which uses a route map and matches on AS path list:

```
add ip aspathlist=2 entry=1 include="^$"
add ip aspathlist=2 entry=2 exclude="15557"
add ip routemap=outdef3 entry=1 action=exclude match
   aspathlist=2
set bgp peer=192.168.200.201 outroutemap=outdef3
```

With both these configurations, the router or switch drops update messages with empty AS paths, and advertises update messages with an AS path containing 15557. For the route map to achieve this (the second configuration):

- The AS path list has to **include** empty paths, so that the empty path matches the path list, and therefore is included into the route map's action of dropping packets that match the path list.
- The AS path list has to **exclude** updates whose AS path includes 15557. This excludes those updates from the route map's action of dropping packets that match the path list, so they are not dropped.

Matching on community list

An entry that matches on **communitylist** lets you select or discard routes that belong to a particular community.

To do this, first create a community list and add entries to it by using one of the commands:

```
add ip communitylist=1..99 [entry=1..4294967295]
   include={internet|noexport|noadvertise|
   noexportsubconfed|aa:xx}[,...]
add ip communitylist=1..99 [entry=1..4294967295]
   exclude={internet|noexport|noadvertise|
   noexportsubconfed|aa:xx}[,...]
```

Then use the community list in the match clause of a route map by using the command:

```
add ip routemap=routemap entry=1..4294967295
   [action={include|exclude}] match community=1..99
   [exact={no|yes}]
```

Note that the action (include/exclude) of the community list and of the route map entry are separate. This leads to the same behaviour as the distinction between the AS path list include/exclude parameters and the route map entry action. For a discussion of the distinction between these two include/exclude actions, see the table in "Matching on AS path list" on page 2-10.

If you specify **exact=yes**, an update message only matches the route map entry if its community attribute contains all the communities specified in the community list, and no other communities. If you specify **exact=no**, which is the default, then the set of communities in the attribute list of the update message must contain all the communities in the specified community list, but can also contain other communities.

Matching on MED

An entry that matches on **med** lets you select or discard routes with a particular Multi Exit Discriminator metric. BGP can use the MED to determine the best route to a destination. To match on MED, use the command:

```
add ip routemap=routemap entry=1..4294967295
    [action={include|exclude}] match med=0..4294967295
```

Matching on next hop

An entry that matches on **nexthop** lets you select or discard routes that traverse a particular node. To do this, use the command:

```
add ip routemap=routemap entry=1..4294967295
    [action={include|exclude}] match nexthop=ipadd
```

Matching on origin

An entry that matches on **origin** lets you select or discard routes depending on how BGP learned them: internally, externally, or from another means (such as statically-configured routes). To do this, use the command:

```
add ip routemap=routemap entry=1..4294967295
    [action={include|exclude}] match
    origin={egp|igp|incomplete}
```

Matching on prefix list

An entry that matches on **prefixlist** lets you select or discard routes to a list of destinations.

To do this, first create the prefix list and add entries to it by using the command:

```
add ip prefixlist=name entry=1..65535
    [action={match|nomatch}] [masklength=range] [prefix=ipadd]
```

See "Creating Prefix Lists" on page 2-8 for more information.

Then use the prefix list in the match clause of a route map by using the command:

```
add ip routemap=routemap entry=1..4294967295
    [action={include|exclude}] match prefixlist=name
```

All the match options described previously—AS path, community, next hop and origin—match on the **attributes** in an update message. Prefix list does not; it matches prefixes.

Note that the action of the prefix list and of the route map entry are separate. Table 2-2 shows the effect of each combination.

Table 2-2: The effect of actions in prefix list and route map entries

Prefix list entry	Route map entry	Action when route map applied
match	include	An update message that contains the prefix matches the route map entry. The prefix is processed.
match	exclude	An update message that contains the prefix matches the route map entry. The prefix is removed from the update message. Other prefixes in the update are not removed.
nomatch	include	An update message that contains the prefix does not match the route map entry. The router or switch continues checking to see if the update message matches other entries in the route map.
nomatch	exclude	An update message that contains the prefix does not match the route map entry. The router or switch continues checking to see if the update message matches other entries in the route map.

In this context, the parameters **match** and **nomatch** in the prefix list do not indicate whether the prefix is allowed or dropped; they simply indicate whether the prefix matches or does not match the prefix list.

Matching on tag

An entry that matches on **tag** lets you select or discard certain static routes for importing into BGP. To do this, first *tag* the routes of interest with an identification number, using one of the commands:

```
add ip route=ipadd interface=interface nexthop=ipadd
   tag=1..65535 [other-options]

set ip route=ipadd interface=interface mask=mask
   nexthop=ipadd tag=1..65535 [other-options]
```

To see which number a route is tagged with, use the command:

```
show ip route
```

Then use the tags in a route map by using the command:

```
add ip routemap=routemap entry=1..4294967295
   [action={include|exclude}] match tag=1..65535
```

How to configure an entry with a set clause

Once you have determined what update messages or prefixes a route map entry matches, you can configure set clauses to change the attributes of matching items.

To create a set clause for an entry, use one of the commands shown in the following table.

Route map set clauses for BGP

Table 2-3: The available set clauses for route maps for BGP

Command	Result
add ip routemap=*routemap* entry=1..4294967295 set aspath={1..65534[,...]}	Adds up to 10 AS numbers at the beginning of the AS path attribute.
add ip routemap=*routemap* entry=1..4294967295 set community={noexport|noadvertise| noexportsubconfed|*aa*:*xx*}[,...]} [add={no|yes}]	Either: • replaces the community attribute with a list of up to 10 community values, if **add=no** (the default), or • adds up to 10 community values to the community attribute, if **add=yes**
add ip routemap=*routemap* entry=1..4294967295 set localpref=0..4294967295	Replaces the existing local_preference attribute, or sets it if it was not already set.
add ip routemap=*routemap* entry=1..4294967295 set med={0..4294967295|remove}	Replaces the existing MED attribute, or sets it if it was not already set, or if you specify **med=remove**, deletes the MED attribute.
add ip routemap=*routemap* entry=1..4294967295 set origin={igp|egp|incomplete}	Replaces the existing origin attribute, or sets it if it was not already set.
add ip routemap=*routemap* entry=1..4294967295 set bgpdampid=1..100	Sets the BGP route flap damping ID that is given to matching routes (see *Damping routes on specific peers* in the BGP chapter of the Software Reference).

A prefix list can match a subset of prefixes in an update message. You can use this to change the attributes of some of the prefixes in an outgoing update, without having to change the attributes of all the prefixes. However, an update message contains just one set of attributes, which must apply to all the prefixes in the update. Therefore, the router or switch splits the original update into two updates:

- one that contains the original attribute values and the prefixes that were not included by the route map entry, and
- one that contains the new attribute values and the prefixes that were included by the route map entry

Creating Route Maps for OSPF

A route map consists of multiple entries, which are in effect individual filters. Each entry specifies both what it matches on, in a *match* clause, and what is done to matching traffic, in the entry's *action* and any *set* clauses it has.

When the router or switch applies a route map to routes for OSPF:

1. It checks the entries in order, starting with the lowest numbered entry, until it finds a match.
2. It then takes the action specified by that entry's action parameter. If the action is **exclude**, it filters out that route. If the action is **include**, it filters in that route.
3. If the action is **include**, it modifies the route characteristics as specified by the entry's set clauses if there are any.
4. It then stops processing that route; it does not check the remaining entries in the route map.

Every route map ends with an implicit entry that matches all routes with an action of **include**. This ensures that if no entries in a route map generate a match, the route is included without modification.

The rest of this section describes:

- **How to create a route map**
- **How to configure an entry with a match clause**
- **How to configure an entry with a set clause**

How to create a route map

You do not have to create a route map as a separate step—adding the first entry automatically creates it.

How to configure an entry with a match clause

The match clause for a route map entry determines which routes match the entry. Each entry can only match on one characteristic. Available characteristics you can use with OSPF are:

- interface
- metric
- next hop
- prefix list
- route source
- route type
- tag

Matching on interface

An entry that matches on interface lets you select or discard all routes whose next hop is reached out that interface. To do this, use the command:

```
add ip routemap=routemap entry=1..4294967295
    [action={include|exclude}] match interface=interface
```

Matching on metric

An entry that matches on **metric** lets you select or discard all routes with that OSPF metric or a metric in that range. To do this, use the command:

```
add ip routemap=routemap entry=1..4294967295
    [action={include|exclude}] match
    metric=0..4294967295[-0..4294967295]
```

Matching on next hop

An entry that matches on **nexthop** lets you select or discard routes that traverse a particular node. To do this, use the command:

```
add ip routemap=routemap entry=1..4294967295
    [action={include|exclude}] match nexthop=ipadd
```

Matching on prefix list

An entry that matches on **prefixlist** lets you select or discard routes to a list of destinations.

To do this, first create the prefix list and add entries to it by using the command:

```
add ip prefixlist=name entry=1..65535
    [action={match|nomatch}] [masklength=range] [prefix=ipadd]
```

See "Creating Prefix Lists" on page 2-8 for more information.

Then use the prefix list in the match clause of a route map by using the command:

```
add ip routemap=routemap entry=1..4294967295
    [action={include|exclude}] match prefixlist=name
```

Note that the action of the prefix list and of the route map entry are separate. The following table shows the effect of each combination.

Table 2-4: The effect of actions in prefix list and route map entries

Prefix list entry	Route map entry	Action when route map applied
match	include	A route to that prefix matches the route map entry. The router or switch adds the route to its RIB.
match	exclude	A route to that prefix matches the route map entry. The router or switch excludes the route from its RIB.
nomatch	include	A route to that prefix does not match the route map entry. The router or switch continues checking to see if the route matches other entries in the route map.
nomatch	exclude	A route to that prefix does not match the route map entry. The router or switch continues checking to see if the route matches other entries in the route map.

In this context, the parameters **match** and **nomatch** in the prefix list do not indicate whether a route to that prefix is allowed or dropped; they simply indicate whether the prefix matches or does not match the prefix list.

Matching on route source

An entry that matches on **routesource** lets you select or discard routes depending on the router ID of the router that they were learnt from.

To do this, first create a prefix list for the router IDs, by using the command:

```
add ip prefixlist=name entry=1..65535
    [action={match|nomatch}] masklength=32 [prefix=ipadd]
```

See "Creating Prefix Lists" on page 2-8 for more information. Note that the mask for a router ID must be 255.255.255.255, so the mask length must be 32.

Then use the prefix list in the match clause of a route map by using the command:

```
add ip routemap=routemap entry=1..4294967295
    [action={include|exclude}] match
    routesource=prefixlist-name
```

Note that the action of the prefix list and of the route map entry are separate. Table 2-4 shows the effect of each combination.

Matching on route type

An entry that matches on **routetype** lets you select or discard particular types of routes: intra-area, inter-area, External Type 1, External Type 2, or other routes. To do this, use the command:

```
add ip routemap=routemap entry=1..4294967295
    [action={include|exclude}] match
    routetype={intra|inter|type1|type2|other}
```

See *Routing with OSPF* in the OSPF chapter of the Software Reference for more information about these route types.

Matching on tag

An entry that matches on **tag** lets you select or discard certain static routes for importing into OSPF.

To do this, first *tag* the routes of interest with an identification number, using one of the commands:

```
add ip route=ipadd interface=interface nexthop=ipadd
    tag=1..65535 [other-options]

set ip route=ipadd interface=interface mask=mask
    nexthop=ipadd tag=1..65535 [other-options]
```

To see which number a route is tagged with, use the command:

```
show ip route
```

Then use the tags in a route map by using the command:

```
add ip routemap=routemap entry=1..4294967295
    [action={include|exclude}] match tag=1..65535
```

How to configure an entry with a set clause

Once you have determined what routes a route map entry matches, you can configure set clauses to change the characteristics of matching items.

To create a set clause for an entry, use one of the commands shown in the following table.

Route map set clauses for OSPF

Command	Result
add ip routemap=*routemap* entry=1..4294967295 set metric=0..4294967295	Sets the OSPF metric of matching routes. Routes with a lower metric are preferred.
add ip routemap=*routemap* entry=1..4294967295 set type={1|2}	Sets the route type of matching routes to External Type 1 or External Type 2. See *Routing with OSPF* in the OSPF chapter of the Software Reference for more information about route types.
add ip routemap=*routemap* entry=1..4294967295 set tag=1..65535	Tags the matching routes with an ID number. You can then use the tag to select routes to import into BGP—see "Filtering when copying routes to BGP" on page 2-23.

Creating IP Route Filters

To create a route filter, use the command:

```
add ip route filter[=filter-id] ip=ipadd mask=ipadd
   action={include|exclude} [direction={receive|send|both}]
   [interface=interface] [nexthop=ipadd] [policy=0..7]
   [protocol={any|ospf|rip}]
```

The **protocol** parameter specifies the routing protocol to which the filter applies. When **direction** is **receive**, then **protocol** specifies the routing protocol that receives the route information. If **direction** is **send**, **protocol** specifies the routing protocol that advertises the routes.

When the routing protocol receives or transmits a route, it searches the list of route filters for a match to the route. The **ip**, **mask**, **interface**, **nexthop**, and **policy** parameters define a pattern to match against. The **action** parameter determines whether routes matching the pattern are used or discarded.

The router or switch checks each route against each filter, starting with the lowest-numbered filter, until it finds a match. Then it applies that filter and stops processing the list of filters.

When you create a list of filters—even a list of only one filter—the router or switch ends the list with an implicit filter to *exclude* all routes. So if you want the router or switch to include all routes that do not match your filters, end your filter list with a filter that matches all routes and includes them, such as:

```
add ip route filter=100 ip=*.*.*.* mask=*.*.*.*
   action=include
```

Creating IP Filters

To create an IP filter that will filter routes, use the command:

```
add ip filter=300..399 action={include|exclude} source=ipadd
    [smask=ipadd] [entry=1..255]
```

The **source** parameter is the network IP address of the subnet to be filtered.

The **smask** parameter determines how many bits of the prefix are significant. When the router or switch checks routes against the filter, it only checks the significant bits.

By default, new entries are added at the end of the filter. If you want the entry to be checked before some of the other entries, give it a lower entry number. This pushes existing entries with the same or higher number further down the list.

You can only use such filters when importing BGP routes into OSPF (see "Applying Filters When Redistributing from the RIB" on page 2-23).

When you are importing routes from BGP into OSPF, you can also limit the total number of routes, by using the **bgplimit** parameter of the **set ospf** command. This limit overrides the effect of the filter—for example, if 2000 routes match the filter but the limit is 1000 routes, only the first 1000 matching routes will be imported. This means you should either:

- make sure that the BGP limit is set higher than the maximum possible number of routes that match your filters, or
- assign low entry numbers to the filter entries that match the most preferred BGP routes. That way, if the number of routes reaches your limit, OSPF will have imported the most important routes.

Applying Filters

This section describes how to apply the filters you have created, to achieve the following results:

- **Applying Filters When Writing to the RIB**
- **Applying Filters When Redistributing from the RIB**
- **Applying Filters Before Advertising Routes**.

For BGP, you can apply several types of filter to each peer. If you do this, the router or switch first applies the AS path filter, then the prefix filter, then the route map. Note that the router or switch stops checking after the first filter entry that excludes the update or prefix, so an update or prefix is only included if all the applied filters result in it being included.

Applying Filters When Writing to the RIB

When the router or switch receives information about a route, it normally adds that route to its RIB. This makes the route available for the router or switch to use. You can use route filters to stop the router or switch from adding certain routes—or routes with certain characteristics—into the RIB. This gives you control over the routes packets take when they leave the router or switch.

Filtering BGP routes when writing to the RIB

Filters act on the BGP update messages that the router or switch receives, or on the routes within update messages. The different types of filter you can use are

- prefix lists
- AS path lists
- route maps

Applying prefix lists

Prefix filtering rejects some of the routes from an update message, without rejecting the whole update. This enables you to configure the router or switch to accept only routes for particular networks from a particular peer.

To use a prefix list as a prefix filter, use one of the commands:

```
add bgp peer=ipadd remoteas=asn [infilter=prefixlist-name]
    [other-options]

set bgp peer=ipadd [infilter=prefixlist-name] [other-options]

add bgp peertemplate=1..30 [infilter=prefixlist-name]
    [other-options]

set bgp peeertemplate=1..30 [infilter=prefixlist-name]
    [other-options]
```

The **infilter** parameter uses the prefix list to filter update messages that the router or switch receives from the peer. If a prefix matches a prefix in the prefix list, BGP rejects that route. Otherwise, it accepts the route.

The router or switch checks every route in the update message against every entry in the filter, starting with the entry with the lowest entry number, until it finds a match or gets to the end of the filter.

You can also use a prefix list in a route map and apply the route map.

Applying AS path lists

To apply an AS path list directly as a filter on a BGP peer, use the command:

```
add bgp peer=ipadd remoteas=asn [inpathfilter=1..99]
    [outpathfilter=1..99] [other-options]
```

The **inpathfilter** parameter applies the AS path list as a filter on update messages that the router or switch receives from the peer. The router or switch only accepts update messages if they match an AS path list entry that has the action **include**. If an update message matches an entry with the action **exclude**, the router or switch rejects the update. If an update message does not match any entry in the AS path list, the router or switch rejects the update. This is because each non-empty AS path list ends with an implicit entry that matches any AS path list and has the action **exclude**.

You can also use an AS path list in a route map and apply the route map.

Applying route maps

To use a route map to filter or modify update messages that it receives from a peer, use one of the commands:

```
add bgp peer=ipadd remoteas=asn inroutemap=routemap
    [other-options]

set bgp peer=ipadd inroutemap=routemap [other-options]
```

The router or switch checks every route in the update message against every entry in the filter, starting with the entry with the lowest entry number, until it finds a match or gets to the end of the filter.

Filtering OSPF routes when writing to the RIB

To filter OSPF routes before adding them to the RIB, first create a route map that matches on the appropriate route characteristics. Then use the route map in the command:

```
set ospf inroutemap=routemap
```

Plan your filters carefully. If a filter excludes a matching route from the RIB, OSPF does not advertise a summary LSA for that route because summary LSA messages are derived from the filtered RIB. This means that incorrect filters can prevent Area Border Routers from advertising routes to other areas.

Filtering RIP routes when writing to the RIB

To filter RIP routes before adding them to the RIB, simply create a filter or series of filters, using the command:

```
add ip route filter[=filter-id] ip=ipadd mask=ipadd
    action={include|exclude} protocol=rip direction=receive
    [other-options]
```

The router or switch automatically applies the filter when importing RIP routes, because **protocol=rip**.

The immediate effect of a route filter with **direction** set to **receive** and **action** set to **exclude** is that route advertisements received matching the filter do not result in a new entry in the local RIB. However, routes already in the RIB are not deleted even when they match the route filter. Therefore, if you dynamically add a route filter at the manager prompt, you may also need to manually delete unwanted routes from the RIB.

Filtering invalid when writing static and interface routes to the RIB

You cannot filter in a way that excludes statically-configured or interface routes from the RIB.

Applying Filters When Redistributing from the RIB

The router or switch is able to import routes from the RIB into BGP, OSPF or RIP, even if it learnt them from a different routing protocol or source. For example, you can add non-BGP routes to BGP, such as static routes and routes learned by OSPF or RIP. BGP can then advertise these routes.

When you import routes from some route sources, you can also filter, to block certain routes. Most of the filtering options use route maps, so you can also give the imported routes certain characteristics, such as changing their metric.

Note that the route map must match on characteristics that are relevant for the routes you are importing. For example, if you are importing routes into BGP, you cannot match on AS path or community. These attributes are not relevant to non-BGP routes.

This section focuses on how to *filter* routes. The router or switch also automatically imports interface routes into OSPF, but cannot filter the routes.

Filtering when copying routes to BGP

BGP can import routes from OSPF and RIP, as well as statically-configured and interface routes. You can use route maps to filter routes from any of these sources. The router or switch uses the route map to filter routes and/or set attributes when it imports the routes into BGP. The following table shows how to filter routes from each source.

From	To filter
OSPF	1. For finest control, tag each OSPF route you want to import into BGP, by creating a route map and applying it to OSPF routes. Use the commands: **add ip routemap**=*routemap* entry=1..4294967295 action={include|exclude} match [*match-options*] **add ip routemap**=*routemap* set tag=1..65535 set ospf inroutemap=*routemap* 2.Create another route map to use when importing into BGP. Match on **nexthop**, **prefixlist** or **tag**. 3. Apply the route map, using the command: add bgp import=ospf routemap=*routemap*
RIP	1. Create a route map, matching on **nexthop** or **prefixlist** 2. Apply the route map, using the command: add bgp import=rip routemap=*routemap*
Interface routes	1. Create a route map, matching on **nexthop** or **prefixlist** 2. Apply the route map, using the command: add bgp import=interface routemap=*routemap*
Static routes	1. For finest control, tag each route you want to include, using the command: set ip route=*ipadd* interface=*interface* mask=*mask* nexthop=*ipadd* tag=1..65535 [*other-options*] 2. Create a route map, matching on **nexthop**, **prefixlist** or **tag** 3. Apply the route map, using the command: add bgp import=static routemap=*routemap*

Filtering when copying routes to OSPF

OSPF:

- can import BGP routes, with or without filtering
- can import RIP routes, with or without filtering
- automatically imports interface routes, without filtering
- can import statically-configured routes, with or without filtering.

The following table shows how to filter routes from RIP, BGP and static routes.

From	How to filter
Static routes	1. For finest control, tag each route you want to include (or each route you want exclude), using one of the commands: add ip route=*ipadd* interface=*interface* nexthop=*ipadd* tag=1..65535 [*other-options*] or set ip route=*ipadd* interface=*interface* mask=*mask* nexthop=*ipadd* tag=1..65535 [*other-options*] 2. Create a route map, matching on **tag**, **metric**, or **routetype.** Static routes are either External Type 1 or External Type 2. 3. Apply the route map, using the command: add ospf redistribute protocol=static routemap=*routemap*
BGP	1. Create an IP filter with filter ID from 300 to 399, matching on source address or prefix 2. Apply the filter, using the command: set ospf bgpfilter=300..399
RIP	1. Turn on importing of RIP routes into OSPF, by using the command: set ospf rip=import [*other-options*] 2. Create IP route filters to determine which RIP routes are copied into the LSA database, by using the command: **add ip route filter**[=*filter-id*] ip=*ipadd* mask=*ipadd* action={include|exclude} protocol=ospf direction=send [*other-options*] The router or switch automatically applies the filter when importing routes into the LSA database, because **protocol=ospf**.

Filtering when copying routes to RIP

RIP can import static and OSPF routes. It also automatically imports interface routes. The following table shows how to filter routes.

From	How to filter
OSPF	1. Turn on exporting of OSPF routes into RIP, by using the command: set ospf rip=export [*other-options*] 2. Create IP route filters to determine which OSPF routes are copied into the LSA database, by using the command: **add ip route filter**[=*filter-id*] ip=*ipadd* mask=*ipadd* action={include|exclude} protocol=rip direction=send [*other-options*] The router or switch automatically applies the filter when importing routes into RIP, because **protocol=rip**.
Static	1. By default, RIP imports and advertises static routes. If this has been turned off, turn it on for the required interfaces by using the command: set ip rip interface=*interface* staticexport=yes [*other-options*] 2. Create IP route filters to determine which static routes are imported, by using the command: **add ip route filter**[=*filter-id*] ip=*ipadd* mask=*ipadd* action={include|exclude} protocol=rip direction=send [*other-options*] The router or switch automatically applies the filter when importing routes into RIP, because **protocol=rip**.
Interface	RIP automatically imports interface routes. Create IP route filters to determine which interface routes are imported, by using the command: **add ip route filter**[=*filter-id*] ip=*ipadd* mask=*ipadd* action={include|exclude} protocol=rip direction=send [*other-options*] The router or switch automatically applies the filter when importing routes into RIP, because **protocol=rip**.

Applying Filters Before Advertising Routes

Routing protocols send their neighbours or peers information about the routes in the router or switch's RIB. You can use route filters to stop the router or switch from advertising certain routes or routes with certain characteristics. This gives you control over the routes that packets take through your network and when leaving your network.

Filtering when using BGP to advertise routes

Filters act on all routes with a particular BGP attribute, or on particular routes. The different types of filter you can use are

- prefix lists
- AS path lists
- route maps

Applying prefix lists

Prefix filtering rejects some of the routes from an update message, without rejecting the whole update. This enables you to configure the router or switch to send only routes for particular networks to a particular peer.

To use a prefix list as a prefix filter, use one of the commands:

```
add bgp peer=ipadd remoteas=asn outfilter=prefixlist-name
   [other-options]

set bgp peer=ipadd outfilter=prefixlist-name [other-options]

add bgp peertemplate=1..30 outfilter=prefixlist-name
   [other-options]

set bgp peeertemplate=1..30 outfilter=prefixlist-name
   [other-options]
```

The **outfilter** parameter uses the prefix list to filter update messages that the router or switch sends to the peer. If a prefix matches a prefix in the prefix list, BGP removes that route from the update message. Otherwise, it leaves the route in the update message and therefore advertises it to the peer.

The router or switch checks every route in the update message against every entry in the filter, starting with the entry with the lowest entry number, until it finds a match or gets to the end of the filter.

For example, to create a peer relationship on the local router or switch, with a peer that has the IP address 192.168.1.1 and is part of AS 1, and prevent the local router or switch from advertising routes from the 10.0.0.0/8 network, use the commands:

```
add ip prefixlist=10_network entry=1 action=match
   prefix=10.0.0.0/8

add bgp peer=192.168.1.1 remotas=1 outfilter=10_network
```

You can also use a prefix list in a route map and apply the route map, as described below.

Applying AS path lists

To apply an AS path list directly as a filter on a BGP peer, use one of the commands:

```
add bgp peer=ipadd remoteas=asn [inpathfilter=1..99]
    [outpathfilter=1..99] [other-options]

set bgp peer=ipadd [inpathfilter=1..99] [outpathfilter=1..99]
    [other-options]
```

The **outpathfilter** parameter applies the AS path list as a filter on update messages that the router or switch sends to the peer. The router or switch only sends update messages if the update's AS path attribute matches an entry that has the action **include**. If a route matches an entry with the action **exclude**, the router or switch does not advertise it to that peer. If an update message does not match any entry in the AS path list, the router or switch does not advertise it to that peer.

You can also use an AS path list in a route map and apply the route map.

Applying route maps

To use the route map to filter or modify update messages that it sends to a peer, use one of the commands:

```
add bgp peer=ipadd remoteas=asn outroutemap=routemap
    [other-options]

set bgp peer=ipadd outroutemap=routemap [other-options]
```

The router or switch checks every route in the update message against every entry in the filter, starting with the entry with the lowest entry number, until it finds a match or gets to the end of the filter.

If your route map is intended to modify the community attribute of outgoing update messages, you also need to enable the router or switch to set the community attribute in messages to that peer. Use one of the commands:

```
add bgp peer=ipadd remoteas=asn outroutemap=routemap
    sendcommunity=yes [other-options]

set bgp peer=ipadd outroutemap=routemap sendcommunity=yes
    [other-options]
```

Filtering invalid when using OSPF to advertise routes

The design of the OSPF protocol does not allow you to filter LSAs before advertising them. This is because OSPF shares LSAs between all the routers in an area. The protocol assumes that all the routers in the area have shared all the advertisements among each other, and that all agree on the state of the complete link state database for the area. If some routers in the area are learning, but not advertising, that breaks the OSPF model.

Therefore, once a route is in the LSA database, you have no control over whether it is advertised.

Filtering when using RIP to advertise routes

To filter routes before advertising them with RIP, create a filter or series of filters, using the command:

```
add ip route filter[=filter-id] ip=ipadd mask=ipadd
   action={include|exclude} protocol=rip direction=send
   [other-options]
```

The router or switch automatically applies the filter when advertising routes to RIP neighbours, because **protocol=rip**.

No mechanism for advertising static and interface routes

Statically-configured and interface routes do not have mechanisms to advertise routes. Only the routing protocols (OSPF, BGP and RIP) advertise routes. To advertise static and interface routes, with or without filtering, import the routes into the required routing protocol.

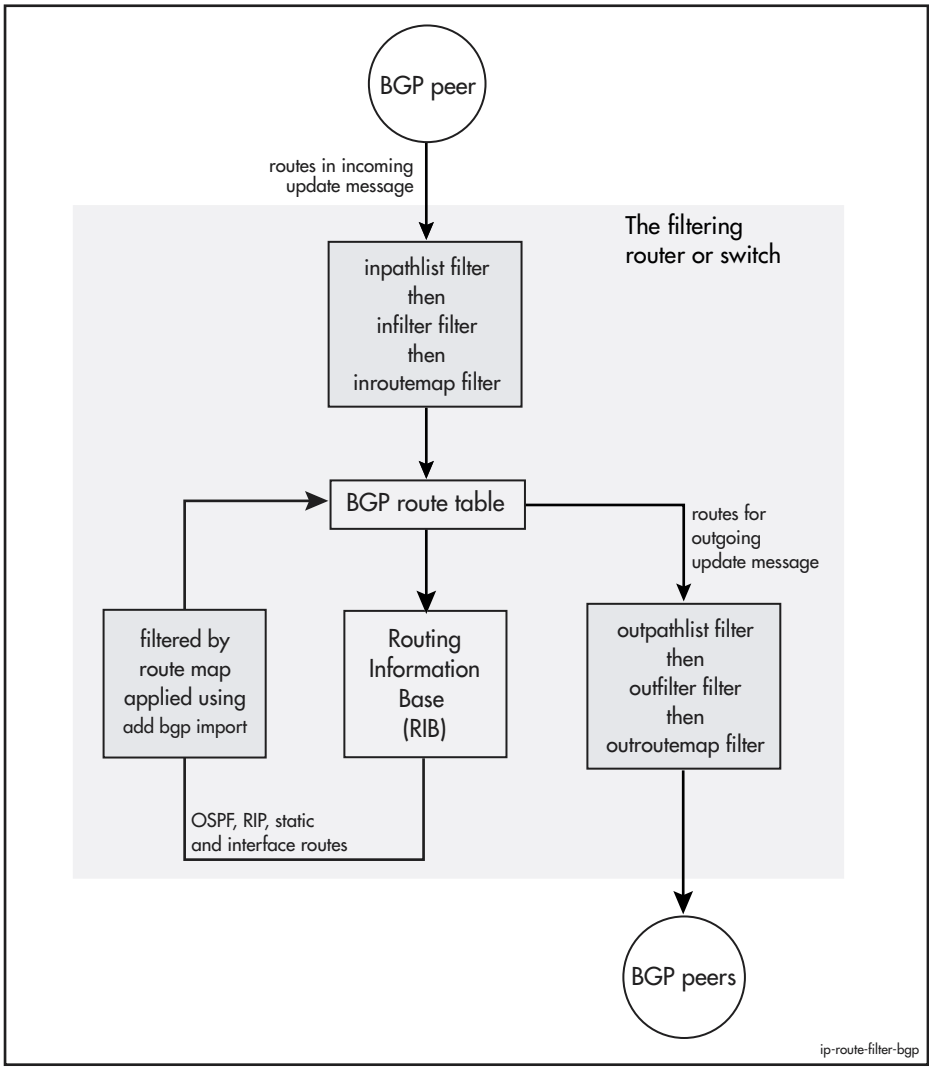
Overview of Filters for each Route Source

The sections above describe each type of filter. This section contains a series of diagrams that summarise the available filters for each route source:

- Border Gateway Protocol (BGP-4)
- Open Shortest Path First (OSPF)
- Routing Information Protocol (RIP)
- Interface Routes
- Statically-Configured Routes

Border Gateway Protocol (BGP-4)

When the router or switch runs BGP, it receives routing information from peer routers. It may also advertise routing information from BGP and other route sources to peer routers. You can filter routing information at the processing points shown in the following figure.

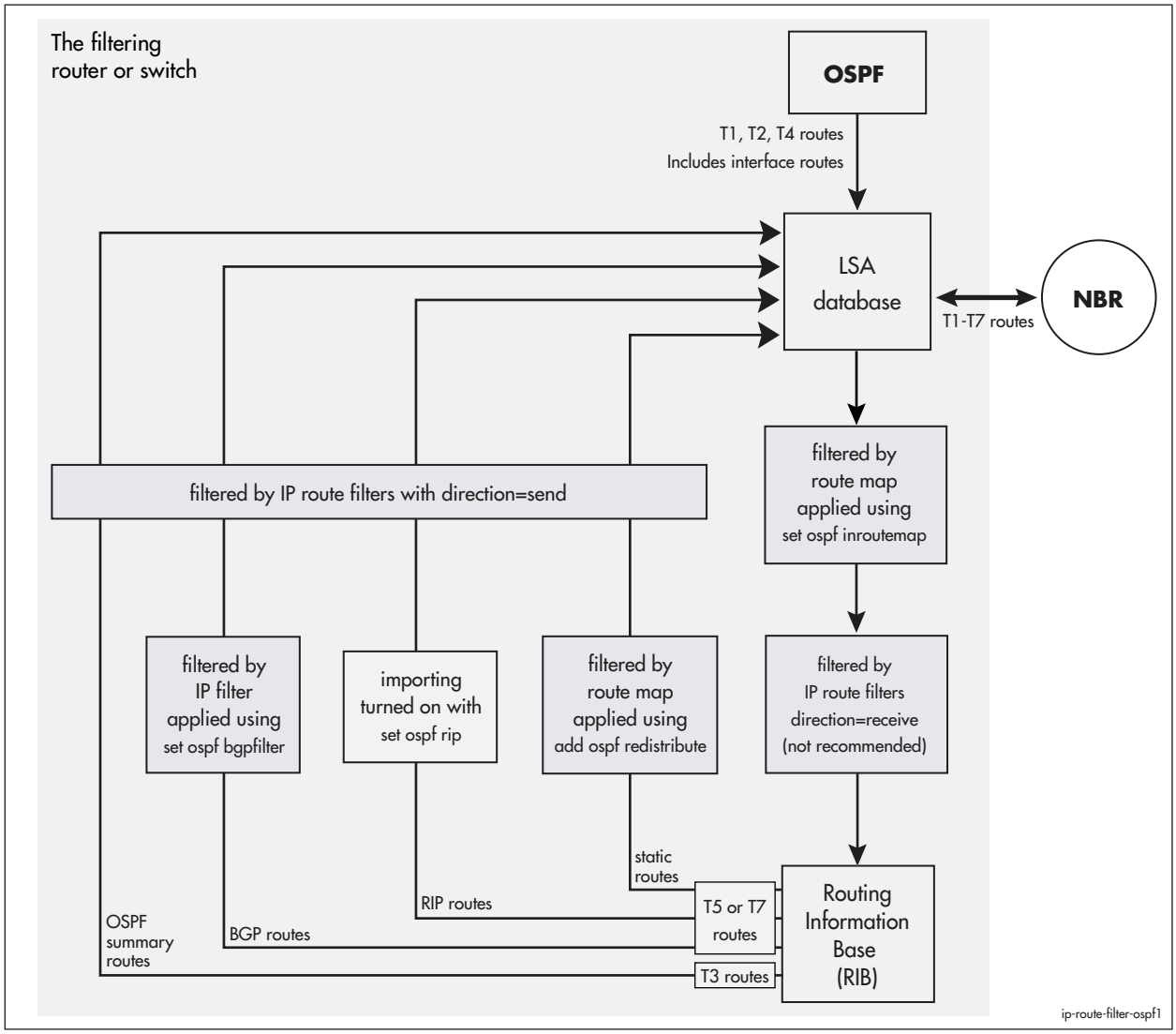


Processing points for route filtering when using BGP

Open Shortest Path First (OSPF)

When the router or switch runs OSPF, it receives routing information from neighbouring routers and advertises routing information to neighbouring routers. This routing information is contained in Link State Advertisements (LSAs). OSPF also generates LSAs internally.

You can filter routing information at the processing points shown in the following figure. The figure also indicates the type of LSA at each processing point.



Processing points for route filtering when using OSPF

The following table describes the different types of LSA.

LSA Name	LSA describes	LSA is created
Type-1 Router-LSA	the state and cost of each of the router or switch's interfaces to the area	by OSPF, on every router in the area
Type-2 Network-LSA	all routers attached to the network	by OSPF, on the network's Designated Router

LSA Name	LSA describes	LSA is created
Type-3 Summary-LSA	inter-area destinations, when the destination is an IP network	from the RIB, by Area Border Routers
Type-4 Summary-LSA	inter-area destinations, when the destination is an Autonomous System (AS) boundary router	by OSPF, by Area Border Routers
Type-5 AS-external-LSA	a destination outside the AS	from the RIB, by AS boundary routers
Type-7 AS-external-LSA	a destination outside the AS. Used in not-so-stubby areas	from the RIB, by AS boundary routers

Limitations of route filtering on OSPF

As the previous diagram shows, the OSPF LSA database is a completely separate entity to the router or switch's RIB. The OSPF design does not allow you to filter the contents of the database before advertising routes to neighbouring routers. This is because OSPF shares LSAs between all the routers in an area. The protocol assumes that all the routers in the area have shared all the advertisements among each other, and that all agree on the state of the complete link state database for the area. If some routers in the area are learning, but not advertising, that breaks the OSPF model.

These limitations mean you can only filter to control:

- which routes learned by OSPF can be imported by the router or switch from the LSA database into the RIB

  We recommend you use route maps to filter this (see "Filtering OSPF routes when writing to the RIB" on page 2-22)

- which static, BGP or RIP routes can be exported from the RIB into the LSA database

  We recommend you use route maps to filter static routes, IP filters to filter BGP routes and IP route filters to filter RIP routes (see "Filtering when copying routes to OSPF" on page 2-24)

- which summary routes can be exported from the RIB into the LSA database for advertising as summary LSAs

  You can use IP route filters to filter this (see "Filtering when copying routes to OSPF" on page 2-24)

  Another way to filter summary LSAs is to define a "do not advertise" OSPF range on an Area Border Router. This stops OSPF from advertising inter-area routes into another area. To do this, use the command:

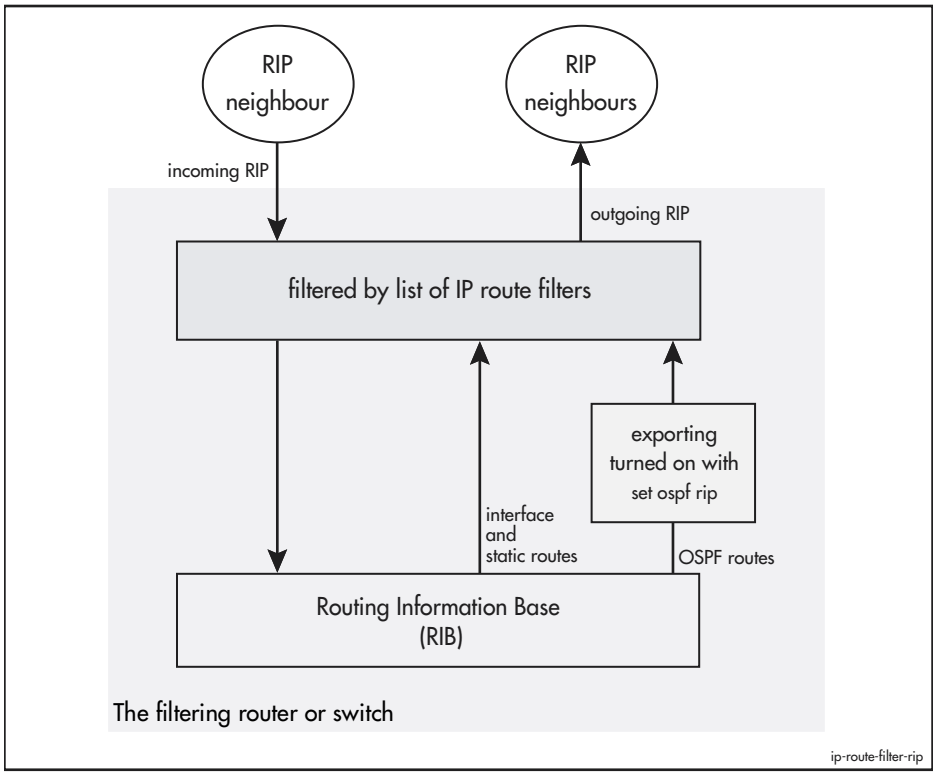
  ```
  set ospf range=ipadd effect=donotadvertise [other-options]
  ```

Note that filtering cannot:

- remove an entry from the LSA database once the entry has been added
- prevent the router or switch from advertising an entry to interfaces in the same area that the entry is relevant to
- prevent updates that OSPF learns from being put into the database
- change the properties of an entry in the database

Routing Information Protocol (RIP)

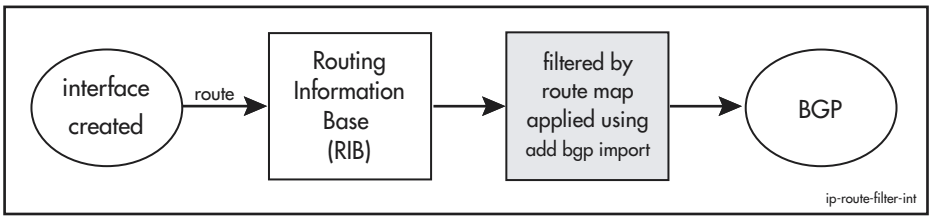
When the router or switch runs RIP, it receives routing information from neighbouring routers, and can advertise RIP, statically-configured and interface routes to neighbouring routers. You can filter routing information at the processing points shown in the following figure.



Interface Routes

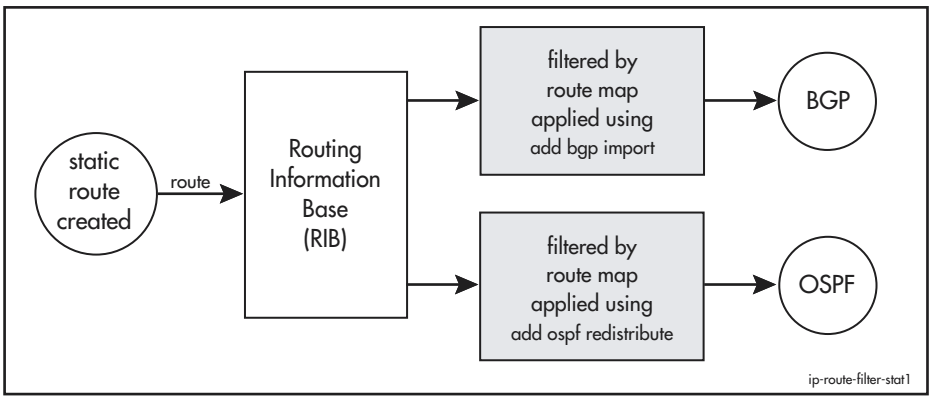
When you create an interface on the router or switch, it automatically creates an interface route. This route tells the router or switch to send packets over that interface when the packets are addressed to the interface's subnet.

Various routing protocols automatically import and advertise interface routes. For BGP, you can filter interface routes when the protocol imports them, as shown in the following figure.



Statically-Configured Routes

You can manually enter routing information into the router or switch, which creates static routes. Dynamic routing protocols import these routes. For BGP and OSPF, you can filter static routes when the protocol imports them, as shown in the following figure.



Configuration Examples

These examples apply filters to BGP routes in the following situations:

- **Filtering When Writing BGP Routes to the RIB: Using an AS Path Filter**
- **Filtering When Writing BGP Routes to the RIB: Using a Route Map**
- **Filtering Before Advertising Routes with BGP: Using an AS Path Filter**
- **Filtering Before Advertising Routes with BGP: Using a Route Map**
- **Filtering Inbound and Outbound BGP Routes: Using Communities**
- **Filtering When Importing Routes from BGP to OSPF**

Filtering When Writing BGP Routes to the RIB: Using an AS Path Filter

This example extends the basic BGP configuration shown in *Basic BGP Configuration* in the BGP chapter of the Software Reference, which connects two routers or switches as EBGP peers and gives:

- Router or Switch A an IP address of 10.0.0.2 and AS number of 65000
- Router or Switch B an IP address of 10.0.0.1 and AS number of 65001

This example uses the **inpathfilter** filteron a BGP peer. It filters received BGP update messages on the basis of their AS path attributes. Therefore, this example stops the router or switch from using routes that originated in a particular AS, or that passed through a particular AS.

To set Router or Switch A to filter out update messages that originate from AS 300

1. **Add an AS path list entry.**

   ```
   add ip aspathlist=1 entry=1 exclude="300$"
   ```

   This AS path list includes all update messages that have originated from any AS except AS 300.

2. **Apply the AS path list to the BGP peer.**

   ```
   set bgp peer=10.0.0.1 inpathfilter=1
   ```

To set Router or Switch A to filter out update messages that originate from AS 300 or pass through AS 200

1. **Add an AS path list entry to exclude update messages that originate in AS 300**

   ```
   add ip aspathlist=1 entry=1 exclude="300$"
   ```

   This AS path list includes all update messages that have originated from any AS except AS 300.

2. **Add an AS path list entry to exclude update messages that go through AS 200**

   ```
   add ip aspathlist=1 entry=2 exclude="200"
   ```

   If a route originated from AS 300 and passes through AS 200, then its update message matches the first entry in the **aspathlist**. BGP does not check the update message against the second entry.

3. **Apply the AS path list to the BGP peer.**

   ```
   set bgp peer=10.0.0.1 inpathfilter=1
   ```

Filtering When Writing BGP Routes to the RIB: Using a Route Map

This example extends the basic BGP configuration shown in *Basic BGP Configuration* in the BGP chapter of the Software Reference, which connects two routers or switches as EBGP peers and gives:

- Router or Switch A an IP address of 10.0.0.2 and AS number of 65000
- Router or Switch B an IP address of 10.0.0.1 and AS number of 65001

This example uses the **inroutemap** filter on a BGP peer. The **inroutemap** filter is applied after all other filters have acted on an update message. This particular route map filters received BGP update messages on the basis of their AS path attributes. It acheives the same effect as the first part of the previous "Filtering When Writing BGP Routes to the RIB: Using an AS Path Filter" example.

Route map filters are sometimes more useful than path filters because route maps can modify the attributes of a received BGP update message. Path filters only include or exclude messages. However, this example does not demonstrate how to modify the message attributes, because it is meaningless to modify attributes and then discard the message.

To set Router or Switch A to filter out update messages that originate from AS 300

1. **Add an AS path list entry.**

```
add ip aspathlist=1 entry=1 include="300$"
```

2. **Add a route map entry.**

```
add ip routemap=as300 entry=1 match aspathlist=1
   action=exclude
```

   This entry matches AS paths that are included in the path list, and excludes them.

3. **Apply the AS path list to the BGP peer.**

```
set bgp peer=10.0.0.1 inroutemap=as300
```

   By default, the router or switch uses all update messages from this peer that do not match the route map.

Filtering Before Advertising Routes with BGP: Using an AS Path Filter

This example extends the basic BGP configuration shown in *Basic BGP Configuration* in the BGP chapter of the Software Reference, which connects two routers or switches as EBGP peers and gives:

- Router or Switch A an IP address of 10.0.0.2 and AS number of 65000
- Router or Switch B an IP address of 10.0.0.1 and AS number of 65001

This example uses the **outpathfilter** filter on a BGP peer. It filters transmitted BGP update messages on the basis of their AS path attributes. Therefore, this example stops the peer from learning routes that originated in a particular AS.

To stop Router or Switch A from advertising update messages to a peer, when the update messages originate from AS 550

1. **Add an AS path list entry.**

   ```
   add ip aspathlist=2 entry=1 exclude="550$"
   ```

2. **Apply the AS path list to the BGP peer.**

   ```
   set bgp peer=10.0.0.1 outpathfilter=1
   ```

   By default, the peer receives all update messages that do not match the path filter.

Filtering Before Advertising Routes with BGP: Using a Route Map

This example extends the basic BGP configuration shown in *Basic BGP Configuration* in the BGP chapter of the Software Reference, which connects two routers or switches as EBGP peers and gives:

- Router or Switch A an IP address of 10.0.0.2 and AS number of 65000
- Router or Switch B an IP address of 10.0.0.1 and AS number of 65001

This example uses the **outroutemap** filteron a BGP peer. The **outroutemap** filter is applied after all other filters have acted on an update message. This particular route map filters transmitted BGP update messages on the basis of their AS path attributes. It acheives the same effect as the previous "Filtering Before Advertising Routes with BGP: Using an AS Path Filter" example.

Route map filters are sometimes more useful than path filters because route maps can modify the attributes of a received BGP update message. Path filters only include or exclude messages. However, this example does not demonstrate how to modify the message attributes, because it is meaningless to modify attributes and then discard the message.

To stop Router or Switch A from advertising update messages to a peer, when the update messages originate from AS 550

1. **Add an AS path list entry.**

```
add ip aspathlist=2 entry=1 include="550"
```

2. **Add a route map entry.**

```
add ip routemap=as550 entry=1 match aspathlist=2
   action=exclude
```

   This entry matches AS paths that are included in the path list, and excludes them.

3. **Apply the route map to the BGP peer.**

```
set bgp peer=10.0.0.1 outroutemap=as550
```

   By default, the peer receives all update messages that do not match the route map.

Filtering Inbound and Outbound BGP Routes: Using Communities

This example extends the basic BGP configuration shown in *Basic BGP Configuration* in the BGP chapter of the Software Reference, which connects two routers or switches as EBGP peers and gives:

- Router or Switch A an IP address of 10.0.0.2 and AS number of 65000
- Router or Switch B an IP address of 10.0.0.1 and AS number of 65001

This example filters inbound and outbound routes on the basis of the community the route belongs to. Router or Switch A assigns routes to different communities depending on the route's subnet. Router or Switch B only accepts routes that belong to one of these communities.

To use the community attributes

1. On Router or Switch A, create route maps that set the community attribute.

The community number is given in the form *as-number*:*community*.

```
add ip routemap=map0 entry=1 set community=2:1
add ip routemap=map1 entry=1 set community=2:2
add ip routemap=map2 entry=1 set community=2:3
add ip routemap=map3 entry=1 set community=2:4
add ip routemap=map4 entry=1 set community=2:5
add ip routemap=map5 entry=1 set community=2:6
add ip routemap=map6 entry=1 set community=2:7
```

2. On Router or Switch A, associate the route maps with subnets.

When BGP imports the routes, the route maps set the community attribute.

```
add bgp net=192.168.0.0/24 routemap=map0
add bgp net=192.168.1.0/24 routemap=map1
add bgp net=192.168.2.0/24 routemap=map2
add bgp net=192.168.3.0/24 routemap=map3
add bgp net=192.168.4.0/24 routemap=map4
add bgp net=192.168.5.0/24 routemap=map5
add bgp net=192.168.6.0/24 routemap=map6
add bgp net=192.168.7.0/24 routemap=map6
add bgp net=192.168.8.0/24 routemap=map6
add bgp net=192.168.9.0/24 routemap=map6
add bgp net=192.168.10.0/24 routemap=map6
```

Note that the community attribute of the last five routes are set to the same value (2:7).

3. On Router or Switch A, set BGP to send the community attribute to the peer (Router or Switch B).

```
set bgp peer=10.0.0.1 sendcommunity=yes
```

4. On Router or Switch B, create a community list.

```
add ip communitylist=1 entry=1 include=2:7
add ip communitylist=1 entry=2 exclude=internet
```

This community list consists of those routes with the community attribute value set to 2:7. All other routes are excluded from the community list.

5. On Router or Switch B, use the community list in a route map.

```
add ip routemap=mapin entry=1 match communitylist=1
add ip routemap=mapin entry=2 action=exclude
```

6. On Router or Switch B, apply the route map to updates from the peer (Router or Switch A).

```
set bgp peer=10.0.0.2 sendcommunity=yes inroutemap=mapin
```

Filtering When Importing Routes from BGP to OSPF

This example supposes that you want to import the route 192.168.72.0 into the OSPF routing domain, but no other routes. This route is received on the gateway router as a BGP route. The following steps show the sequence of commands to use in this scenario.

1. Set up the IP filter:

   ```
   add ip filter=300 source=192.168.72.0 smask=255.255.255.255
      action=include
   ```

2. Set up OSPF BGP import parameters:

   ```
   set ospf bgpimport=on bgpfilter=300 bgplimit=1
   ```

3. Check that BGP has added the route to the IP route table:

   ```
   show ip route=192.168.72.0
   ```

   The route should be visible in the output of the command.

4. Check that OSPF has imported the route:

   ```
   show ospf lsa=192.168.72.0
   ```

   The output should show that there is an AS external LSA with this ID.

Command Reference

This section describes the commands available on the router or switch to configure IP route filtering.

The shortest valid command is denoted by capital letters in the Syntax section. See *Conventions* in About this Software Reference in the front of the Software Reference for details of the conventions used to describe command syntax. See Appendix A, Messages for a complete list of messages and their meanings.

add ip aspathlist

Syntax

```
ADD IP ASPATHlist=1..99 [ENTry=1..4294967295]
   INCLude=aspath-reg-exp

ADD IP ASPATHlist=1..99 [ENTry=1..4294967295]
   EXCLude=aspath-reg-exp
```

Description

This command adds an entry to an AS path list, and creates the list if it does not already exist. You must specify the index number of the AS path list, and may also specify the position of the entry in the list.

When the router or switch searches through an AS path list, the first entry that causes a match stops the search, returning the result **include** or **exclude** depending on the type of entry. A totally empty AS path list is identical to an AS path list that matches all AS paths and is of type **include**. Any non-empty AS path list has an implicit entry at the end that matches all AS paths and is of type **exclude**.

Parameter	Description
ASPATHlist	The ID number of the AS path list. You can create up to 99 AS path lists. Default: no default
ENTry	The desired position of the new entry in the AS path list once the entry has been added. Entries are numbered from 1 to the number of entries in the list. Default: The entry is added to the end of the list

Parameter (cont.)	**Description** (cont.)
INCLude	An AS path regular expression, which specifies the AS path values that this entry includes in this AS path list. When you use the AS path list in a route map or filter, the map or filter carries out its specified action on update messages with a matching AS path attribute value. Regular expressions are a list of one or more AS numbers, separated by spaces. To match from the first number in the list, start the expression with the ^ character. To match the last number, end with the $ character. If the expression contains spaces, surround it with double quotes. For more information about valid syntax, see Table 2-1 on page 2-9. For example: • **include="23334 45634 88988"** includes any path containing these numbers • **include="^23334 45634 88988$"** includes only that exact path • **include=^23334** includes any path that begins with 23334 Default: no default
EXCLude	An AS path regular expression, which specifies the AS path values that this entry excludes from this AS path list. When you use the AS path list in a route map or filter, the map or filter does not carry out its specified action on update messages with a matching AS path attribute value. Regular expressions are a list of one or more AS numbers, separated by spaces. To match from the first number in the list, start the expression with the ^ character. To match the last number, end with the $ character. If the expression contains spaces, surround it with double quotes. For more information about valid syntax, see Table 2-1 on page 2-9. For example: • **exclude="23334 45634 88988"** excludes any path containing these numbers • **exclude="^23334 45634 88988$"** excludes only that exact path • **exclude=23334$** excludes any path that ends with 23334 Default: no default

Examples

To add an entry to AS path list 1 that matches all AS paths and excludes them, use the command:

```
add ip aspath=1 excl=.*
```

To add an entry to AS path list 2 that matches an empty AS path and includes it, use the command:

```
add ip aspath=2 incl=^$
```

Related Commands

add ip routemap
delete ip aspathlist
show ip aspathlist

add ip communitylist

Syntax

```
ADD IP COMmunitylist=1..99 [ENTry=1..4294967295]
   INCLude={INTernet|NOExport|NOAdvertise|
   NOEXPORTSubconfed|aa:xx}[,...]

ADD IP COMmunitylist=1..99 [ENTry=1..4294967295]
   EXCLude={INTernet|NOExport|NOAdvertise|
   NOEXPORTSubconfed|aa:xx}[,...]
```

Description This command adds an entry to a community list, and creates the list if it does not already exist. You must specify the index number of the community list, and may also specify the position of the entry in the list.

Parameter	Description	
COMmunitylist	The ID number of the community list. You can create up to 99 lists. Default: no default	
ENTry	The desired position of the new entry in the community list once the entry has been added. Entries are numbered from 1 to the number of entries in the list. Default: The entry is added to the end of the list	
INCLude	A community name, community number, or comma-separated list of names and numbers, which specifies the communities that this entry includes in this community list. When you use the community list in a route map or filter, the map or filter carries out its specified action on update messages with a matching community attribute value. Default: no default	
	INTernet	The community of routes that can be advertised to all BGP peers.
	NOExport	The community of routes that must not be advertised outside a BGP confederation boundary (a standalone autonomous system that is not part of a confederation should be considered a confederation itself).
	NOAdvertise	The community of routes that must not be advertised to other BGP peers.
	NOEXPORTSubconfed	The community of routes that must not be advertised to external BGP peers (this includes peers in other members' autonomous systems inside a BGP confederation).
	aa:*xx*	The number of a community. ***aa*** and ***xx*** are both integers in the range 0 to 65534. ***aa*** is the AS number. ***xx*** is a value chosen by the ASN administrator.

Parameter (cont.)	**Description** (cont.)	
EXCLude	A community name, community number, or comma-separated list of names and numbers, which specifies the communities that this entry excludes from this community list. When you use the community list in a route map or filter, the map or filter does not carry out its specified action on update messages with a matching community attribute value. Default: no default	
	INTernet	The community of routes that can be advertised to all BGP peers.
	NOExport	The community of routes that must not be advertised outside a BGP confederation boundary (a standalone autonomous system that is not part of a confederation should be considered a confederation itself).
	NOAdvertise	The community of routes that must not be advertised to other BGP peers.
	NOEXPORTSubconfed	The community of routes that must not be advertised to external BGP peers (this includes peers in other members' autonomous systems inside a BGP confederation).
	aa:*xx*	The number of a community. ***aa*** and ***xx*** are both integers in the range 0 to 65534. ***aa*** is the AS number. ***xx*** is a value chosen by the ASN administrator.

Examples To add an entry to community list 1 that matches communities attributes that contain the communities NOEXPORT and 70000 and excludes them, use the command:

```
add ip com=1 excl=noe 70000
```

Related Commands

add ip routemap
delete ip communitylist
show ip communitylist

add ip prefixlist

Syntax

```
ADD IP PREFIXList=name ENTry=1..65535
   [ACTion={MATch|NOMatch}] [MASklength=range]
   [PREfix=ipadd]
```

Description This command adds a numbered *entry* to a prefix list. If the prefix list does not already exist, this command first creates it. You can create up to 400 prefix lists, with up to 1000 entries in each list.

Parameter	Description
PREFIXList	A name to identify the prefix list. A string 1 to 15 characters long. Valid characters are uppercase letters (A-Z), lowercase letters (a-z), digits (0-9) and the underscore character ("_"). If *name* contains spaces, it must be in double quotes. Default: no default
ENTry	An integer to specify the position of the new entry in the prefix list. When the router or switch uses a prefix list, it checks the entries in order, starting with the lowest, until it finds a match. Therefore, give more specific entries lower numbers than general entries. If you leave gaps between entry numbers, you can add future entries between existing entries. Each prefix list has an implicit final entry that matches all addresses, with an action of **nomatch**. Default: no default
ACTion	Whether matching prefixes are included or excluded by the process that is using the prefix list. You can use multiple entries in a prefix list with actions of **match** and **nomatch** to build up a list of prefixes. Prefixes with **action=match** are included in the list. Then to use this list of prefixes, create a route map that matches it and apply the route map in a route filtering process. The route map also has an **action** parameter, which determines whether the filtering process includes or excludes the prefixes in the list. Default: **match**

MATch	The prefix list includes the prefix.
NOMatch	The prefix list excludes the prefix.

Parameter (cont.)	**Description** (cont.)
MASklength	The range of prefix mask lengths matched by this entry in the prefix list. The *range* is either a single CIDR mask from 0 to 32, or two masks separated by a hyphen. These options are valid for setting the mask length: • as a mask length range (**masklength=*a*-*b*)**. For a route to match against this entry, its prefix mask length must be between *a* and *b* inclusive. *a* must be less than *b*. • as a single mask length (**masklength=*a***). For a route to match against this entry, its prefix mask length must be exactly *a*. • as an implicit mask length, by not specifying **masklength** (for example, **prefix=192.168.0.0**). For a route to match against this entry, its prefix mask length must correspond exactly to the mask for the class of the given address; in this example, 24. Default: The natural mask for the prefix, based on whether it is a class A, B, or C network
PREfix	The network address matched by this entry in the prefix list, specified in dotted decimal notation. If you do not specify a prefix, the router or switch sets it to 0.0.0.0. This is correct if you are matching all routes or the default route. Default: 0.0.0.0

Examples To match only routes from the 192.168.0.0/16 network, use the command:

```
add ip prefixlist=sample1 entry=1 action=match
   prefix=192.168.0.0 masklength=16
```

To match all routes in all 192.168.0.0 networks, except those in the 192.168.7.0 network, use the commands:

```
add ip prefixlist=sample2 entry=1 action=nomatch
   prefix=192.168.7.0 masklength=24-32

add ip prefixlist=sample2 entry=2 action=match
   prefix=192.168.0.0 masklength=16-32
```

To exclude the default route, use the command:

```
add ip prefixlist=sample3 entry=1 action=nomatch masklength=0
```

To include all routes, use the command:

```
add ip prefixlist=sample4 entry=1 action=match
   masklength=0-32
```

Related Commands

add ip routemap
delete ip prefixlist
set ip prefixlist
set ip routemap
show ip prefixlist

add ip route filter

Syntax

```
ADD IP ROUte FILter[=filter-id] IP=ipadd MASK=ipadd
   ACtion={INCLude|EXCLude|SWItch}
   [DIrection={RECeive|SENd|BOTH}] [INTerface=interface]
   [NEXThop=ipadd] [POLIcy=0..7] [PROTocol={ANY|OSPF|RIP}]
```

Description This command creates a route filter. A route filter controls which routes RIP receives and advertises, and which external routes OSPF copies into its LSA database.

Parameter	Description	
FILter	The ID number of the filter, in the range 1 to 100. Default: no default (the filter is added to the end of the list of currently-defined filters)	
IP	The network address to match. You can use the wildcard character ("*") to match a network range. For example, 192.168.*.* matches all destination networks that start with 192.168. The wildcard character can only replace a complete number. For example, 192.168.*.* is valid but 192.16*.*.* is not. Default: no default	
MASK	The network mask of the network to match. You can use the wildcard character ("*") to match a network mask range. For example, 255.255.*.* matches all destination network masks that start with 255.255. The wildcard character can only replace a complete number. For example, 255.255.*.* is valid but 255.25*.*.* is not. Default: no default	
ACtion	What the router or switch does with routes that match the filter. Default: no default	
	INCLude	The router or switch includes matching routes in its RIB or the advertisement.
	EXCLude	The router or switch excludes matching routes from its RIB or the advertisement.
	SWItch	The router or switch learns matching routes and adds them to the special default IP route table in hardware. The default IP route table can contain up to 16 summary routes.

Parameter (cont.)	**Description** (cont.)	
DIrection	Whether the router or switch applies this filter to routes that the routing protocol receives or routes that it advertises. The routing protocol is specified using the **protocol** parameter. Default: **both**	
	RECeive	The router or switch applies this filter to routes that the routing protocol receives, to determine whether to write those routes into the RIB. If **protocol=ospf**, a route filter with **direction=receive** filters routes when copying them from the LSA database to the RIB. If a filter excludes a matching route from the RIB, OSPF does not advertise a summary LSA for that route because summary LSA messages are derived from the filtered RIB. This means that incorrect filters can prevent Area Border Routers from advertising routes to other areas. Plan your filters carefully.
	SENd	The router or switch applies this filter to routes, to determine whether the routing protocol will advertise the routes. If **protocol=ospf**, a route filter with **direction=send** only matches AS external routes (BGP, RIP and static routes) and summary routes.
	BOTH	The router or switch applies this filter to determine which routes to write into the RIB and which routes to advertise.
INTerface	The interface to which the filter applies. The router or switch only uses this filter on routes that are received on this interface, or that will be advertised out this interface. Valid interfaces are: • eth (such as eth0, eth0-1) • ATM (such as atm0.1) • PPP (such as ppp0, ppp1-1) • FR (such as fr0, fr0-1) • X.25 DTE (such as x25t0, x25t0-1) • VLAN (such as vlan1, vlan1-1) To see a list of interfaces currently available, use the **show ip interface** command. If **protocol=ospf**, this parameter has no effect. The router or switch always applies the filter on all interfaces. Default: no default (the router or switch applies this filter to routes on all interfaces)	
NEXThop	The IP address of the next hop router. If you specify this, the router or switch applies this filter to routes that specify this next hop. Default: no default	
POLIcy	The value of the route's Type of Service, from 0 to 7. The filter matches routes with this TOS setting. Default: no default	

Parameter (cont.)	**Description** (cont.)	
PROTocol	The routing protocol to which the filter applies. If **direction** is **receive**, then **protocol** specifies the routing protocol that receives the route information. If **direction** is **send**, then **protocol** specifies the routing protocol that advertises the routes. Default: **any**	
	OSPF	Open Shortest Path First
	RIP	Routing Information Protocol
	ANY	Both RIP and OSPF

Examples To add a route filter that includes RIP-derived routes from all sources, use the command:

```
add ip rou fil=1 prot=rip ac=incl di=both ip=*.*.*.*
   mask=*.*.*.*
```

To exclude all routes received from the 10.0.0.0 network from the route table, but include all other received routes in the route table, use the commands:

```
add ip rou fil=1 ip=10.0.0.0 mask=255.0.0.0 ac=excl di=rec
add ip rou fil=2 ip=*.*.*.* mask=*.*.*.* ac=incl
```

The second filter is necessary to override the effect of the implicit "exclude all" following the last entry in a filter list.

Related Commands

delete ip route filter
set ip route filter
show ip route filter

add ip routemap

Syntax for an empty entry

```
ADD IP ROUTEMap=routemap ENTry=1..4294967295
   [ACtion={INCLude|EXCLude}]
```

Syntax for a *match* clause

```
ADD IP ROUTEMap=routemap ENTry=1..4294967295
   [ACtion={INCLude|EXCLude}] MAtch ASPath=1..99

ADD IP ROUTEMap=routemap ENTry=1..4294967295
   [ACtion={INCLude|EXCLude}] MAtch COMmunity=1..99
   [EXAct={NO|YES}]

ADD IP ROUTEMap=routemap ENTry=1..4294967295
   [ACtion={INCLude|EXCLude}] MAtch INTerface=interface

ADD IP ROUTEMap=routemap ENTry=1..4294967295
   [ACtion=INCLude] MAtch MED=0..4294967295

ADD IP ROUTEMap=routemap ENTry=1..4294967295
   [ACtion={INCLude|EXCLude}] MAtch
   METric=0..4294967295[-0..4294967295]

ADD IP ROUTEMap=routemap ENTry=1..4294967295
   [ACtion={INCLude|EXCLude}] MAtch NEXThop=ipadd

ADD IP ROUTEMap=routemap ENTry=1..4294967295
   [ACtion={INCLude|EXCLude}] MAtch
   ORIGin={EGP|IGP|INCOmplete}

ADD IP ROUTEMap=routemap ENTry=1..4294967295
   [ACtion={INCLude|EXCLude}] MAtch
   PREFIXList=prefixlist-name

ADD IP ROUTEMap=routemap ENTry=1..4294967295
   [ACtion={INCLude|EXCLude}] MAtch
   ROUTESource=prefixlist-name

ADD IP ROUTEMap=routemap ENTry=1..4294967295
   [ACtion={INCLude|EXCLude}] MAtch
   ROUTEType={INTRA|INTER|TYPE1|TYPE2|OTHER}

ADD IP ROUTEMap=routemap ENTry=1..4294967295
   [ACtion={INCLude|EXCLude}] MAtch TAG=1..65535
```

Syntax for a *set* clause

```
ADD IP ROUTEMap=routemap ENTry=1..4294967295
   [ACtion=INCLude] SET ASPath={1..65534[,...]}

ADD IP ROUTEMap=routemap ENTry=1..4294967295
   [ACtion=INCLude] SET
   COMmunity={NOExport|NOAdvertise|NOEXPORTSubconfed|
   aa:xx}[,...]} [ADD={NO|YES}]

ADD IP ROUTEMap=routemap ENTry=1..4294967295
   [ACtion=INCLude] SET BGPDampid=1..100

ADD IP ROUTEMap=routemap ENTry=1..4294967295
   [ACtion=INCLude] SET LOCalpref=0..4294967295
```

```
ADD IP ROUTEMap=routemap ENTry=1..4294967295
   [ACtion=INCLude] SET MED={0..4294967295|REMOVE}

ADD IP ROUTEMap=routemap ENTry=1..4294967295
   [ACtion=INCLude] SET METric=0..4294967295

ADD IP ROUTEMap=routemap ENTry=1..4294967295
   [ACtion=INCLude] SET ORIGin={IGP|EGP|INCOmplete}

ADD IP ROUTEMap=routemap ENTry=1..4294967295
   [ACtion=INCLude] SET TYpe={1|2}

ADD IP ROUTEMap=routemap ENTry=1..4294967295
   [ACtion={INCLude|EXCLude}] SET TAG=1..65535
```

Description This command adds a numbered *entry* to a route map, or adds a *clause* to an existing entry in a route map. If the route map does not already exist, this command first creates it.

Route maps are made up of a list of entries. Each entry contains:

- zero or one **match** clause, to determine which routes or BGP update messages the entry applies to. If an entry does not have a match clause, the effect is that it matches everything.
- one **action**, to determine whether matching routes or BGP update messages are included or excluded by the process that is using the route map (by default matching items are included).
- zero, one, or more **set** clauses, to change certain features of matching routes or the attributes of matching BGP updates. Most **set** clauses change the attributes of matching update messages. Each entry can have at most one **set** clause of a given type.

Parameters for both *match* and *set* clauses

Parameter	Description
ROUTEMap	The name of the route map to add the entry or clause to. The *routemap* is a character string 0 to 15 characters long. Valid characters are uppercase and lowercase letters, digits (0-9), and the underscore character. Default: no default
ENTry	An integer to specify the position of the new entry in the route map. When a routing protocol uses a route map, it checks the entries in order, starting with the lowest, until it finds a match. If you leave gaps between entry numbers, you can add future entries between existing entries. Be careful when specifying the entry number. If you make an error in the number (for example, enter entry=11 instead of entry=1), the router or switch adds a new entry to the route map. Default: no default
ACtion	Whether matching prefixes or update messages are included or excluded by the process that is using the route map. The **action** parameter applies to the entire entry, but you can change it at the same time as you add a clause. The most recently entered value of this parameter applies to the entire entry. It is not meaningful to have **action=exclude** in an entry with a set clause. Default: the current setting. If there is no current setting, **include**

Parameters for *match* clauses

Parameter	Description
MAtch	Adds a **match** clause to the entry, to determine which routes or BGP update messages the entry applies to. A route map entry can have zero or one **match** clauses. An entry without a **match** clause matches all routes or updates.
ASPath	The ID number of an AS path list. An update message matches the route map entry if its AS path attribute matches the AS path list. To configure an AS path list use the **add ip aspathlist** command on page 2-40. Valid when filtering BGP routes. Default: no default
COMmunity	The ID number of a community list. An update message matches the route map entry if its community attribute matches the community list.To configure a community list use the **add ip communitylist** command on page 2-42. Valid when filtering BGP routes. Default: no default

Parameter (cont.)	**Description** (cont.)	
EXAct	Whether the community attribute in an update message must precisely match the route map's community list. Only valid when you specify both **match** and **community**. Default: **no**	
	YES	An update message only matches the route map entry if its community attribute contains all the communities specified in the community list and only those communities.
	NO	An update message still matches the route map entry if its community attribute contains all the communities specified in the community list plus extra communities.
INTerface	A router or switch interface. A route matches the route map entry if its next hop is out the specified interface. Valid interfaces are: • eth (such as eth0, eth0-1) • ATM (such as atm0.1) • PPP (such as ppp0, ppp1-1) • FR (such as fr0, fr0-1) • X.25 DTE (such as x25t0, x25t0-1) • VLAN (such as vlan1, vlan1-1) To see a list of interfaces currently available, use the **show interface** command. Valid when filtering OSPF routes. Default: no default	
MED	The update message's Multi_Exit_Discriminator attribute. EBGP uses the MED to determine the optimal path for reaching the advertised prefixes. A lower metric indicates a preferred path. IBGP does not use this attribute. An update message matches the route map entry if its MED attribute matches this value. Valid when filtering BGP routes. Default: no default	
METric	The OSPF metric or a range of metric values. A route matches the route map entry if its OSPF metric equals this value or is in this range. Valid when filtering OSPF routes. Default: no default	
NEXThop	The IP address of the next node in the path to the route's destination, specified in dotted decimal notation. For BGP, an update message matches the route map entry if its next_hop attribute matches this address. Valid when filtering routes from any source. Default: no default	
ORIGin	An origin attribute value, which indicates BGP's source for the routes at their originating AS. An update message matches the route map entry if its origin attribute matches this value. Valid when filtering BGP routes. Default: no default	
	IGP	The original source of the route was IGP.
	EGP	The original source of the route was EGP.
	INCOmplete	The original source of the route was neither IGP or EGP. This includes statically-configured routes.

Parameter (cont.)	**Description** (cont.)	
PREFIXList	The name of a prefix list. A route matches the route map entry if the prefix list contains that route. To create a list use the **add ip prefixlist** command on page 2-44. Valid when filtering routes from any source. Default: no default	
ROUTESource	The name of a prefix list that lists one or more router IDs. A route matches the route map entry if the prefix list contains the router ID of the router that advertised the route to OSPF. To create a prefix list use the **add ip prefixlist** command on page 2-44. Note that the mask for a router ID must be 255.255.255.255, so the mask length must be 32. Valid when filtering OSPF routes. Default: no default	
ROUTEType	The type of route, which indicates whether the route is within the OSPF area, to another area with the same AS, or to another AS. See *Routing with OSPF* in the OSPF chapter of the Software Reference for more information about these route types. Valid when filtering OSPF routes. Default: no default	
	INTRA	A route matches the route map entry if it is an OSPF intra-area route.
	INTER	A route matches the route map entry if it is an OSPF inter-area route.
	TYPE1	A route matches the route map entry if it is an OSPF External Type 1 route.
	TYPE2	A route matches the route map entry if it is an OSPF External Type 2 route.
	OTHER	A route matches the route map entry if it is not one of the above route types.
TAG	A tag that identifies a particular route. A route matches this route map entry if it has been tagged with this value. There are two ways of tagging routes. You can use a route map to set the route's tag, or for static routes you can use the **tag** parameter of the **add ip route** command. For BGP, you can use a route map that matches on **tag** when you use the **add bgp import** command to import static routes from the RIB to BGP. However, BGP routes do not have a tag field in their path attributes. Therefore, you cannot use **tag** to filter routes that are sent to BGP peers or to match update messages that are received from BGP peers. For OSPF, you can use a route map that matches on **tag** when you use the **add ospf redistribute** command to import static routes from the RIB to OSPF. Default: no default	

Parameters for *set* clauses

Parameter	Description	
SET	Adds a **set** clause to the entry. For BGP, this modifies an attribute in update messages that match the entry. For OSPF, this modifies characteristics of routes that match the entry. A route map entry can have zero, one or more **set** clauses, but can only modify each attribute once. An entry without a **set** clause does not modify any attributes.	
ASPath	A comma-separated list of 1 to 10 AS numbers. These numbers are added to the beginning of the update message's AS path attribute. Valid for BGP. Default: no default	
COMmunity	A comma-separated list of 1 to 10 communities, identified by name or number. If the **add** parameter is **yes**, these communities are added to the update message's community attribute. If the **add** parameter is **no** (its default), these communities replace the update message's community attribute. Note that you must also set the peer's **sendcommunity** parameter to **yes** if you want the peer to include the community attribute in the update messages it sends. By default, peers do not include the community attribute in outgoing updates. Valid for BGP. Default: no default	
	INTernet	The community of routes that can be advertised to all BGP peers.
	NOExport	The community of routes that must not be advertised outside a BGP confederation boundary (a standalone autonomous system that is not part of a confederation should be considered a confederation itself).
	NOAdvertise	The community of routes that must not be advertised to other BGP peers.
	NOEXPORTSubconfed	The community of routes that must not be advertised to external BGP peers (this includes peers in other members' autonomous systems inside a BGP confederation).
	aa:*xx*	The number of a community. ***aa*** and ***xx*** are both integers in the range 0 to 65534. ***aa*** is the AS number. ***xx*** is a value chosen by the ASN administrator.
ADD	Whether the list of communities specified by the **community** parameter is added to the community attribute, or replaces the community attribute. Only valid when you specify both **set** and **community**. Default: **no**	
	YES	The communities are added to the update message's community attribute.
	NO	The communities replace the update message's community attribute.

Parameter (cont.)	**Description** (cont.)	
BGPDampid	The BGP route flap damping ID that is given to matching routes. This is the same as the ID number of the parameter set that maintains that route's FoM upon it exhibiting instability. If the parameter set does not exist, the default parameter set is applied to matching routes. For more information about using route maps when configuring route flap damping, see *Damping routes on specific peers* in the BGP chapter of the Software Reference. Valid for BGP. Default: no default	
LOCalpref	The metric to write into the update message's local_preference attribute. IBGP uses the local preference to determine which path it should use inside the AS to reach the advertised prefix. A lower metric indicates a preferred path. EBGP does not use this attribute. Valid for BGP. Default: no default	
MED	The metric to write into the update message's Multi_Exit_Discriminator attribute. EBGP uses the MED to determine the optimal path for reaching the advertised prefixes. A lower metric indicates a preferred path. IBGP does not use this attribute. Valid for BGP. Default: no default	
	0..4294967295	This value is written into the MED attribute of the matched update message.
	REMOVE	The MED attribute is removed from the matched update message.
METric	The OSPF metric to give to the route. Valid for OSPF. Default: no default	
ORIGin	The value to write into the update message's origin attribute. The origin indicates BGP's source for the routes at their originating AS. Valid for BGP. Default: no default	
	IGP	The original source of the route was IGP.
	EGP	The original source of the route was EGP.
	INCOmplete	The original source of the route was neither IGP or EGP. This includes statically-configured routes.
TAG	A number to label matching routes with. Tagging routes allows you to identify the route's original source, for example, in the output of the **show ip route** command. Valid when importing static routes into OSPF. Default: no default	
TYpe	The OSPF external route type to set the route to. This enables you to ensure that all externally-sourced OSPF routes are the same type and therefore use the same method to calculate route metrics. Valid for OSPF. Default: no default	

Examples To add a route map entry that sets the community attribute to 489816064 for all BGP routes, use the command:

```
add ip routem=set_comm ent=10 set com=489816064
```

This command creates the route map, adds an entry to it, and adds a set clause to the entry. No match clause is required because we wish to match all routes. To use this route map for routes being sent to BGP peer 192.168.1.1, use the command:

```
set bgp peer=192.168.1.1 outr=set_comm
```

To add a route map entry number 10 that selects all routes with an OSPF metric in the range 5 to 15, use the command:

```
add ip routem=metric_ent=10 ma met=5-15
```

Related Commands
delete ip routemap
set ip routemap
show ip routemap

delete ip aspathlist

Syntax `DELete IP ASPATHlist=1..99 [ENTry=1..4294967295]`

Description This command deletes an entry from an AS path list or deletes an entire AS path list. You cannot delete an AS path list if a route map is using it, or if a peer is using it as a filter. First use the **match** parameter of the **delete ip routemap** command on page 2-59 to delete the route map entry, or the **set bgp peer** command in the BGP chapter of the Software Reference to remove the filter association.

Parameter	Description
ASPATHlist	The ID number of the AS path list to delete, or to remove an entry from. Default: no default
ENTry	The number of the entry to delete. If you do not specify an entry, the whole AS path list is deleted. Default: no default

Examples To delete the third entry in AS path list 1, use the command:

```
del ip aspath=1 ent=3
```

To delete AS path list 1 and all its entries, use the command:

```
del ip aspath=1
```

Related Commands
add ip aspathlist
show ip aspathlist

delete ip communitylist

Syntax `DELete IP COMmunitylist=1..99 [ENTry=1..4294967295]`

Description This command deletes an entry from a community list or the entire list. You cannot delete a community list if a route map is using it. First use the **match** parameter of the **delete ip routemap** command on page 2-59 to delete the route map entry.

Parameter	Description
COMmunitylist	The ID number of the community list to delete, or to remove an entry from. Default: no default
ENTry	The number of the entry to delete. If you do not specify an entry, the whole community list is deleted. Default: no default

Examples To delete the entire community list 1, use the command:

```
del ip com=1
```

Related Commands
add ip communitylist
show ip communitylist

delete ip prefixlist

Syntax `DELete IP PREFIXList[=name] [ENTry=1..65535]`

Description This command deletes:

- an entry from a particular prefix list if you specify a name in the **prefixlist** parameter and an **entry** number
- a prefix list if you specify a name in the **prefixlist** parameter but do not specify an **entry** number
- all prefix lists if you do not specify a name in the **prefixlist** parameter or an **entry** number

You cannot delete a prefix list if a route map is using it. Delete the route map entry first.

Examples To delete entry 2 from the prefix list “office”, use the command:

```
del ip prefixl=office entry=2
```

Related Commands
add ip prefixlist
delete ip routemap
set ip routemap
show ip prefixlist

delete ip route filter

Syntax `DELete IP ROUte FILter=1..100`

Description This command deletes a route filter. A route filter controls which routes are sent and received by the routing protocols.

The **filter** parameter specifies the index in the filter list of the filter to delete. The specified entry must exist.

Examples To delete route filter 3, use the command:

```
del rou fil=3
```

Related Commands

add ip route filter
set ip route filter
show ip route filter

delete ip routemap

Syntax

```
DELete IP ROUTEMap=routemap

DELete IP ROUTEMap=routemap ENTry=1..4294967295

DELete IP ROUTEMap=routemap ENTry=1..4294967295
   MAtch={ASPath|COMmunity|INTerface|MED|METric|NEXThop|
   ORIGin|PREFIXList|ROUTESource|ROUTEType|TAG}

DELete IP ROUTEMap=routemap ENTry=1..4294967295
   SET={ASPath|COMmunity|LOCalpref|MED|METric|ORIGin|TAG|
   TYpe}
```

Description

This command deletes one of:

- an entire route map
- a single entry in a route map, or
- a match or set clause in an entry in a route map

You cannot delete a whole route map if OSPF or a BGP peer is using it, or if a BGP aggregate, network or import process is using it.

Parameter	Description
ROUTEMap	The name of the route map to be deleted or the name of the route map from which an entry, match clause, or set clause is to be deleted. Default: no default
ENTry	The number of the entry in the route map to be deleted, or the number of the entry from which a match clause or set clause is to be deleted. The entry must already exist in the route map. If you do not specify an entry, the whole route map is deleted. Default: no default
MAtch	The type of match clause to be deleted from the route map entry. Since only one match clause is allowed in a route map entry, this uniquely identifies the clause. Default: no default
SET	The type of set clause to be deleted from the route map entry. Since only one set clause of each type is allowed in a route map entry, this uniquely identifies the clause. Default: no default

Examples

To delete the localpref set clause from entry 10 in route map “set_loc_pref”, use the command:

```
del ip routem=set_loc_pref ent=10 set=loc
```

To delete the next hop match clause from entry 10 in route map “nexthop”, use the command:

```
del ip routem=nexthop ent=10 ma=next
```

Related Commands

add ip routemap
set ip routemap
show ip routemap

set ip prefixlist

Syntax

```
SET IP PREFIXList=name ENTry=1..65535
   [ACTion={MATch|NOMatch}] [MASklength=range]
   [PREfix=ipadd]
```

Description This command modifies an existing entry in a prefix list.

Parameter	Description
PREFIXList	A name that identifies the prefix list. Default: no default
ENTry	An integer that specifies the position of the entry in the prefix list. Default: no default
ACTion	Whether matching prefixes are included or excluded by the process that is using the prefix list. You can use multiple entries in a prefix list with actions of **match** and **nomatch** to build up a list of prefixes. Prefixes with **action=match** are included in the list. Then to use this list of prefixes, create a route map that matches it and apply the route map in a route filtering process. The route map also has an **action** parameter, which determines whether the filtering process includes or excludes the prefixes in the list. Default: **match** MATch — The prefix list includes the prefix. NOMatch — The prefix list excludes the prefix.
MASklength	The range of prefix mask lengths matched by this entry in the prefix list. The *range* is either a single CIDR mask from 0 to 32, or two masks separated by a hyphen. These options are valid for setting the mask length: • as a mask length range (**masklength=*a*-*b*)**. For a route to match against this entry, its prefix mask length must be between *a* and *b* inclusive. *a* must be less than *b*. • as a single mask length (**masklength=*a***). For a route to match against this entry, its prefix mask length must be exactly *a*. • as an implicit mask length, by not specifying **masklength** (for example, **prefix=192.168.0.0**). For a route to match against this entry, its prefix mask length must correspond exactly to the mask for the class of the given address; in this example, 24. Default: The natural mask for the prefix, based on whether it is a class A, B, or C network
PREfix	The network address matched by this entry in the prefix list, specified in dotted decimal notation. If you do not specify a prefix, the router or switch sets it to 0.0.0.0. This is correct if you are matching all routes or the default route. Default: 0.0.0.0

Examples To modify entry 1 in prefix list sample1 so that it matches only routes from the 192.168.0.0/16 network, use the command:

```
set ip prefixlist=sample1 entry=1 action=match
   prefix=192.168.0.0 masklength=16
```

Related Commands

add ip prefixlist
add ip routemap
delete ip prefixlist
set ip routemap
show ip prefixlist

set ip route filter

Syntax

```
SET IP ROUte FILter=filter-id [IP=ipadd] [MASK=ipadd]
   [ACtion={INCLude|EXCLude|SWItch}]
   [DIrection={RECeive|SENd|BOTH}] [INTerface=interface]
   [NEXThop=ipadd] [POLIcy=0..7] [PROTocol={ANY|OSPF|RIP}]
```

where:

- *filter-id* is a number from 1 to 100.
- *ipadd* is an IP address in dotted decimal notation.
- *interface* is an interface name formed by concatenating a Layer 2 interface type, an interface instance, and optionally a hyphen followed by a logical interface number from 0 to 15. If a logical interface is not specified, 0 is assumed.

Description This command modifies a route filter. A route filter controls which routes are sent and received by the routing protocols. Route filters do not apply to static or interface routes.

Parameter	Description	
FILter	The ID number of the filter, in the range 1 to 100. Default: no default	
IP	The network address to match. You can use the wildcard character ("*") to match a network range. For example, 192.168.*.* matches all destination networks that start with 192.168. The wildcard character can only replace a complete number. For example, 192.168.*.* is valid but 192.16*.*.* is not. Default: no default	
MASK	The network mask of the network to match. You can use the wildcard character ("*") to match a network mask range. For example, 255.255.*.* matches all destination network masks that start with 255.255. The wildcard character can only replace a complete number. For example, 255.255.*.* is valid but 255.25*.*.* is not. Default: no default	
ACtion	What the router or switch does with routes that match the filter. Default: no default	
	INCLude	The router or switch includes matching routes in its RIB or the advertisement.
	EXCLude	The router or switch excludes matching routes from its RIB or the advertisement.
	SWItch	The router or switch learns matching routes and adds them to the special default IP route table in hardware. The default IP route table can contain up to 16 summary routes.

Parameter (cont.)	**Description** (cont.)	
DIrection	Whether the router or switch applies this filter to routes that the routing protocol receives or routes that it advertises. The routing protocol is specified using the **protocol** parameter. Default: **both**	
	RECeive	The router or switch applies this filter to routes that the routing protocol receives, to determine whether to write those routes into the RIB.
	SENd	The router or switch applies this filter to routes, to determine whether the routing protocol will advertise the routes. Note that the nature of the OSPF protocol affects how route filtering works on OSPF Link State Advertisement (LSA). A route filter with **direction=send** only matches Autonomous System (AS) external routes. Also, the router or switch ignores the **interface** parameter, so it applies the filter on all interfaces.
	BOTH	The router or switch applies this filter to determine which routes to write into the RIB and which routes to advertise.
INTerface	The interface to which the filter applies. The router or switch only uses this filter on routes that are received on this interface, or that will be advertised out this interface. Valid interfaces are: • eth (such as eth0, eth0-1) • ATM (such as atm0.1) • PPP (such as ppp0, ppp1-1) • FR (such as fr0, fr0-1) • X.25 DTE (such as x25t0, x25t0-1) • VLAN (such as vlan1, vlan1-1) To see a list of interfaces currently available, use the **show interface** command. If **protocol=ospf**, the router or switch ignores this setting when filtering routes to advertise. Default: no default (the router or switch applies this filter to routes on all interfaces)	
NEXThop	The IP address of the next hop router. If you specify this, the router or switch applies this filter to routes that specify this next hop. Default: no default	
POLIcy	The value of the route's Type of Service, from 0 to 7. The filter matches routes with this TOS setting. Default: no default	
PROTocol	The routing protocol to which the filter applies. If **direction** is **receive**, then **protocol** specifies the routing protocol that receives the route information. If **direction** is **send**, then **protocol** specifies the routing protocol that advertises the routes. Default: **any**	
	OSPF	Open Shortest Path First
	RIP	Routing Information Protocol
	ANY	Both RIP and OSPF

Examples To modify route filter 1 to include only OSPF-derived routes, use the command:

```
set ip rou fil=1 prot=ospf
```

Related Commands

add ip route filter
delete ip route filter
show ip route filter

set ip routemap

Syntax to change the action

```
SET IP ROUTEMap=routemap ENTry=1..4294967295
   [ACtion={INCLude|EXCLude}]
```

Syntax to change a *match* clause

```
SET IP ROUTEMap=routemap ENTry=1..4294967295
   [ACtion={INCLude|EXCLude}] MAtch ASPath=1..99

SET IP ROUTEMap=routemap ENTry=1..4294967295
   [ACtion={INCLude|EXCLude}] MAtch COMmunity=1..99
   [EXAct={NO|YES}]

SET IP ROUTEMap=routemap ENTry=1..4294967295
   [ACtion={INCLude|EXCLude}] MAtch INTerface=interface

SET IP ROUTEMap=routemap ENTry=1..4294967295
   [ACtion=INCLude] MAtch MED=0..4294967295

SET IP ROUTEMap=routemap ENTry=1..4294967295
   [ACtion={INCLude|EXCLude}] MAtch
   METric=0..4294967295[-0..4294967295]

SET IP ROUTEMap=routemap ENTry=1..4294967295
   [ACtion={INCLude|EXCLude}] MAtch NEXThop=ipadd

SET IP ROUTEMap=routemap ENTry=1..4294967295
   [ACtion={INCLude|EXCLude}] MAtch
   ORIGin={EGP|IGP|INCOmplete}

SET IP ROUTEMap=routemap ENTry=1..4294967295
   [ACtion={INCLude|EXCLude}] MAtch
   PREFIXList=prefixlist-name

SET IP ROUTEMap=routemap ENTry=1..4294967295
   [ACtion={INCLude|EXCLude}] MAtch
   ROUTESource=prefixlist-name

SET IP ROUTEMap=routemap ENTry=1..4294967295
   [ACtion={INCLude|EXCLude}] MAtch
   ROUTEType={INTRA|INTER|TYPE1|TYPE2|OTHER}

SET IP ROUTEMap=routemap ENTry=1..4294967295
   [ACtion={INCLude|EXCLude}] MAtch TAG=1..65535
```

Syntax to change a *set* clause

```
SET IP ROUTEMap=routemap ENTry=1..4294967295
   [ACtion=INCLude] SET ASPath={1..65534[,...]}

SET IP ROUTEMap=routemap ENTry=1..4294967295
   [ACtion=INCLude] SET
   COMmunity={NOExport|NOAdvertise|NOEXPORTSubconfed|
   aa:xx}[,...]} [ADD={NO|YES}]

SET IP ROUTEMap=routemap ENTry=1..4294967295
   [ACtion=INCLude] SET BGPDampid=1..100
```

```
SET IP ROUTEMap=routemap ENTry=1..4294967295
   [ACtion=INCLude] SET LOCalpref=0..4294967295

SET IP ROUTEMap=routemap ENTry=1..4294967295
   [ACtion=INCLude] SET MED={0..4294967295|REMOVE}

SET IP ROUTEMap=routemap ENTry=1..4294967295
   [ACtion=INCLude] SET METric=0..4294967295

SET IP ROUTEMap=routemap ENTry=1..4294967295
   [ACtion=INCLude] SET ORIGin={IGP|EGP|INCOmplete}

SET IP ROUTEMap=routemap ENTry=1..4294967295
   [ACtion=INCLude] SET TYpe={1|2}

SET IP ROUTEMap=routemap ENTry=1..4294967295
   [ACtion={INCLude|EXCLude}] SET TAG=1..65535
```

Description

This command does one of the following:

- changes the **action** of an entry in a route map
- modifies an entry's **match** clause
- modifies an entry's **set** clause

This command does not create or delete an entry or clause. To create a new entry or clause, use the **add ip routemap** command on page 2-49. To delete an entry or clause, use the **delete ip routemap** command on page 2-59.

Parameters for both *match* and *set* clauses

Parameter	Description
ROUTEMap	The name of the route map that the entry or clause belongs to. Default: no default
ENTry	The ID number of the entry to change. Default: no default
ACtion	Whether matching prefixes or update messages are included or excluded by the process that is using the route map. The **action** parameter applies to the entire entry. It is not meaningful to have **action=exclude** in an entry with a set clause. Default: the current setting. If there is no current setting, **include**

Parameters for *match* clauses

Parameter	Description
MAtch	Modifies the **match** clause in the entry. The **match** clause determines which routes or BGP update messages the entry applies to. A route map entry can have zero or one **match** clauses. An entry without a **match** clause matches all routes or updates.
ASPath	The ID number of an AS path list. An update message matches the route map entry if its AS path attribute matches the AS path list. To configure an AS path list use the **add ip aspathlist** command on page 2-40. Valid when filtering BGP routes. Default: no default
COMmunity	The ID number of a community list. An update message matches the route map entry if its community attribute matches the community list.To configure a community list use the **add ip communitylist** command on page 2-42. Valid when filtering BGP routes. Default: no default
EXAct	Whether the community attribute in an update message must precisely match the route map's community list. Only valid when you specify both **match** and **community**. Default: **no** YES — An update message only matches the route map entry if its community attribute contains all the communities specified in the community list and only those communities. NO — An update message still matches the route map entry if its community attribute contains all the communities specified in the community list plus extra communities.
INTerface	A router or switch interface. A route matches the route map entry if its next hop is out the specified interface. Valid interfaces are: • eth (such as eth0, eth0-1) • ATM (such as atm0.1) • PPP (such as ppp0, ppp1-1) • FR (such as fr0, fr0-1) • X.25 DTE (such as x25t0, x25t0-1) • VLAN (such as vlan1, vlan1-1) To see a list of interfaces currently available, use the **show interface** command. Valid when filtering OSPF routes. Default: no default
MED	The update message's Multi_Exit_Discriminator attribute. EBGP uses the MED to determine the optimal path for reaching the advertised prefixes. A lower metric indicates a preferred path. IBGP does not use this attribute. An update message matches the route map entry if its MED attribute matches this value. Valid when filtering BGP routes. Default: no default

Parameter (cont.)	**Description** (cont.)	
METric	The OSPF metric or a range of metric values. A route matches the route map entry if its OSPF metric equals this value or is in this range. Valid when filtering OSPF routes. Default: no default	
NEXThop	The IP address of the next node in the path to the route's destination, specified in dotted decimal notation. For BGP, an update message matches the route map entry if its next_hop attribute matches this address. Valid when filtering routes from any source. Default: no default	
ORIGin	An origin attribute value, which indicates BGP's source for the routes at their originating AS. An update message matches the route map entry if its origin attribute matches this value. Valid when filtering BGP routes. Default: no default	
	IGP	The original source of the route was IGP.
	EGP	The original source of the route was EGP.
	INCOmplete	The original source of the route was neither IGP or EGP. This includes statically-configured routes.
PREFIXList	The name of a prefix list. A route matches the route map entry if the prefix list contains that route. To create a list use the **add ip prefixlist** command on page 2-44. Valid when filtering routes from any source. Default: no default	
ROUTESource	The name of a prefix list that lists one or more router IDs. A route matches the route map entry if the prefix list contains the router ID of the router that advertised the route to OSPF. To create a prefix list use the **add ip prefixlist** command on page 2-44. Note that the mask for a router ID must be 255.255.255.255, so the mask length must be 32. Valid when filtering OSPF routes. Default: no default	

Parameter (cont.)	**Description** (cont.)	
ROUTEType	The type of route, which indicates whether the route is within the OSPF area, to another area with the same AS, or to another AS. See *Routing with OSPF* in the OSPF chapter of the Software Reference for more information about these route types. Valid when filtering OSPF routes. Default: no default	
	INTRA	A route matches the route map entry if it is an OSPF intra-area route.
	INTER	A route matches the route map entry if it is an OSPF inter-area route.
	TYPE1	A route matches the route map entry if it is an OSPF External Type 1 route.
	TYPE2	A route matches the route map entry if it is an OSPF External Type 2 route.
	OTHER	A route matches the route map entry if it is not one of the above route types.
TAG	A tag that identifies a particular route. A route matches this route map entry if it has been tagged with this value. There are two ways of tagging routes. You can use a route map to set the route's tag, or for static routes you can use the **tag** parameter of the **add ip route** command. For BGP, you can use a route map that matches on **tag** when you use the **add bgp import** command to import static routes from the RIB to BGP. However, BGP routes do not have a tag field in their path attributes. Therefore, you cannot use **tag** to filter routes that are sent to BGP peers or to match update messages that are received from BGP peers. For OSPF, you can use a route map that matches on **tag** when you use the **add ospf redistribute** command to import static routes from the RIB to OSPF. Default: no default	

Parameters for *set* clauses

Parameter	Description	
SET	Modifies a **set** clause in the entry. For BGP, **set** clauses modify an attribute in update messages that match the entry. For OSPF, **set** clauses modify characteristics of routes that match the entry. A route map entry can have zero, one or more **set** clauses, but can only modify each attribute once. An entry without a **set** clause does not modify any attributes.	
ASPath	A comma-separated list of 1 to 10 AS numbers. These numbers are added to the beginning of the update message's AS path attribute. Valid for BGP. Default: no default	
COMmunity	A comma-separated list of 1 to 10 communities, identified by name or number. If the **add** parameter is **yes**, these communities are added to the update message's community attribute. If the **add** parameter is **no** (its default), these communities replace the update message's community attribute. Note that you must also set the peer's **sendcommunity** parameter to **yes** if you want the peer to include the community attribute in the update messages it sends. By default, peers do not include the community attribute in outgoing updates. Valid for BGP. Default: no default	
	INTernet	The community of routes that can be advertised to all BGP peers.
	NOExport	The community of routes that must not be advertised outside a BGP confederation boundary (a standalone autonomous system that is not part of a confederation should be considered a confederation itself).
	NOAdvertise	The community of routes that must not be advertised to other BGP peers.
	NOEXPORTSubconfed	The community of routes that must not be advertised to external BGP peers (this includes peers in other members' autonomous systems inside a BGP confederation).
	aa:*xx*	The number of a community. ***aa*** and ***xx*** are both integers in the range 0 to 65534. ***aa*** is the AS number. ***xx*** is a value chosen by the ASN administrator.
ADD	Whether the list of communities specified by the **community** parameter is added to the community attribute, or replaces the community attribute. Only valid when you specify both **set** and **community**. Default: **no**	
	YES	The communities are added to the update message's community attribute.
	NO	The communities replace the update message's community attribute.

Parameter (cont.)	**Description** (cont.)	
BGPDampid	The BGP route flap damping ID that is given to matching routes. This is the same as the ID number of the parameter set that maintains that route's FoM upon it exhibiting instability. If the parameter set does not exist, the default parameter set is applied to matching routes. For more information about using route maps when configuring route flap damping, see *Damping routes on specific peers* in the BGP chapter of the Software Reference. Valid for BGP. Default: no default	
LOCalpref	The metric to write into the update message's local_preference attribute. IBGP uses the local preference to determine which path it should use inside the AS to reach the advertised prefix. A lower metric indicates a preferred path. EBGP does not use this attribute. Valid for BGP. Default: no default	
MED	The metric to write into the update message's Multi_Exit_Discriminator attribute. EBGP uses the MED to determine the optimal path for reaching the advertised prefixes. A lower metric indicates a preferred path. IBGP does not use this attribute. Valid for BGP. Default: no default	
	0..4294967295	This value is written into the MED attribute of the matched update message.
	REMOVE	The MED attribute is removed from the matched update message.
METric	The OSPF metric to give to the route. Valid for OSPF. Default: no default	
ORIGin	The value to write into the update message's origin attribute. The origin indicates BGP's source for the routes at their originating AS. Valid for BGP. Default: no default	
	IGP	The original source of the route was IGP.
	EGP	The original source of the route was EGP.
	INCOmplete	The original source of the route was neither IGP or EGP. This includes statically-configured routes.
TAG	A number to label matching routes with. Tagging routes allows you to identify the route's original source, for example, in the output of the **show ip route** command. Valid when importing static routes into OSPF. Default: no default	
TYpe	The OSPF external route type to set the route to. This enables you to ensure that all externally-sourced OSPF routes are the same type and therefore use the same method to calculate route metrics. Valid for OSPF. Default: no default	

Examples To change a route map entry number 10 so that it selects all routes with an OSPF metric in the range 5 to 15, use the command:

```
set ip routem=metric_ent=10 ma met=5-15
```

To change the MED for an existing set MED clause in entry 10 of the route map called set_med, use the command:

```
set ip routem=set_med ent=10 set med=234
```

Related Commands

add ip routemap
delete ip routemap
show ip routemap

show ip aspathlist

Syntax `SHow IP ASPATHlist[=1..99]`

Description This command displays information about a specific AS path list or all lists in the router or switch (Figure 2-2, Table 2-5).

Figure 2-2: Example output from the **show ip aspathlist** command

```
IP AS path lists

List    Entry    Regular expression
----------------------------------------
1       1        Include ^$
        2        Exclude .*
----------------------------------------
34      1        Exclude ^123
        2        Include 345 234.+123
        3        Exclude .*
----------------------------------------
```

Table 2-5: Parameters in the output of the **show ip aspathlist** command

Parameter	Meaning
List	AS path list number from 1 to 99.
Entry	Entry in the AS path list from 1 to the number of entries in the list.
Regular expression	AS path regular expression for this entry. This is preceded by "exclude" or "include" to indicate what the router or switch does when there is a a match. For a description of regular expressions, see Table 2-1 on page 2-9.

Examples To display AS path list number 23, use the command:

```
sh ip aspath=23
```

Related Commands

add ip aspathlist
delete ip aspathlist

show ip communitylist

Syntax `SHow IP COMmunitylist[=1..99] [OLDcommunityformat]`

Description This command displays information about a specific community list or all lists in the router or switch (Figure 2-3, Table 2-6).

The **communitylist** parameter specifies the community list to display. If a list is not specified, all are displayed.

The **oldcommunityformat** parameter specifies that community numbers are displayed in the old format. This is an integer calculated by:

```
AS number x 65536 + community value
```

Figure 2-3: Example output from the **show ip communitylist** command

```
IP community lists

List     Entry     Community list
-----------------------------------------------
 1       1         Include noexport,1234:2345
         2         Exclude 34567:123
 -----------------------------------------------
 23      1         Exclude 12:34
         2         Include internet
 -----------------------------------------------
```

Table 2-6: Parameters in the output of the **show ip communitylist** command

Parameter	Meaning
List	Number of community list from 1 to 99.
Entry	Entry in the community list from 1 to the number of entries in the list.
Community list	The community list for this entry, preceded by "exclude" or "include" to indicate whether a match means that the community attribute should be excluded or included in the function for which the community list is being used.

Examples To display all IP community lists, use the command:

```
sh ip com
```

Related Commands

add ip communitylist
delete ip communitylist

show ip prefixlist

Syntax `SHow IP PREFIXList[=name]`

Description This command displays information about prefix lists on the router or switch. If you specify a prefix list name, detailed information about that prefix list and its entries is displayed (Figure 2-5, Table 2-8). Otherwise, summary information about all existing prefix lists is displayed (Figure 2-4, Table 2-7).

Figure 2-4: Example summary output from the **show ip prefixlist** command

```
IP Prefix Lists
Name              Entries     In Use
-------------------------------------
Sample                 11     Yes
Test                    3     No
-------------------------------------
```

Table 2-7: Parameters in the output of the **show ip prefixlist** command

Parameter	Meaning
Name	The name of the prefix list.
Entries	The number of entries in the prefix list.
In Use	Whether the prefix list is currently assigned to a route map.

Figure 2-5: Example detailed output from the **show ip prefixlist** command

```
IP Prefix List
-----------------------------------------------------------------------
 Name ................... Sample
 In Use ................. Yes
 Entries:
   Number       Action         Prefix            Length Range
   ---------------------------------------------------------------
        1       Match          192.168.0.0                16
        3       No Match       0.0.0.0                 25-30
       10       No Match       10.10.10.0              24-30
   ---------------------------------------------------------------
```

Table 2-8: Parameters in the detailed output of the **show ip prefixlist** command

Parameter	Meaning
Name	Name of the prefix list.
In Use	Whether the prefix list is currently assigned to a route map.
Number	The entry number of the prefix list entry. The router or switch checks entries in order, starting with the lowest entry number.
Action	Whether the prefix list includes (“match”) or excludes (“nomatch”) any prefix that is within the entry’s prefix range.
Prefix	IP network address for the entry to match on.
Length Range	Range of CIDR mask lengths that the entry can match on.

Examples To see the entries in prefix list “office”, use the command:

```
sh ip prefixl=office
```

Related Commands

add ip prefixlist
add ip routemap
delete ip prefixlist
set ip routemap

show ip route filter

Syntax `SHow IP ROUte FILter`

Description This command displays information about configured IP route filters (Figure 2-6, Table 2-9).

Figure 2-6: Example output from the **show ip route filter** command

```
IP Route Filters
-------------------------------------------------------------------------------
Ent.    IP Address        Mask              Nexthop           Policy      Matched
        Protocol          Direction         Interface         Action
-------------------------------------------------------------------------------
  1     0.0.0.0           0.0.0.0           Any               0                 0
        RIP               Both              -                 Include

        Request: 1               Passes: 1               Fails: 0
-------------------------------------------------------------------------------
```

Table 2-9: Parameters in output of the **show ip route filter** command

Parameter	Meaning
Ent.	The filter number.
IP Address	The IP address of the network that is filtered.
Mask	The network mask for the network address.
Nexthop	The next hop to which the filter applies.
Policy	The policy or type of service to which the filter applies.
Matched	The number of times this pattern has been matched.
Protocol	The routing protocol to which the filter applies.
Direction	Whether the filter applies to routes the router or switch receives, advertises, or both.
Interface	The interface to which the filter applies.
Action	Whether matching routes are included or excluded.
Action	Whether matching routes are included, excluded, or copied to the router or switch's hardware default IP route table.

Related Commands

add ip route filter
delete ip route filter
set ip route filter

show ip routemap

Syntax `SHow IP ROUTEMap[=routemap] [OLDcommunityformat]`

where *routemap* is a character string 0 to 15 characters long. Valid characters are uppercase and lowercase letters, digits (0-9), and the underscore character ("_").

Description This command displays information about all IP route maps or a specific one (Figure 2-7, Table 2-10).

The **routemap** parameter specifies the name of the route map to display. If one is not specified, information about all route maps is displayed.

The **oldcommunityformat** parameter specifies that community numbers are displayed in the old format. This is an integer calculated by:

```
AS number x 65536 + community value
```

Figure 2-7: Example output from the **show ip routemap** command

```
IP route maps

Map name
  Entry        Action
      Clauses
-------------------------------------------------------
bgp
  1            Include
     match     Community   12 Exact=no
       set     LocalPref   3245
       set     Med         8726
       set     Origin      incomplete
  12345        Include
       set     Community   12 noadvertise Add=yes
  4294967295   Include
       set     AS-path     44
       set     Local Pref  3245
       set     Med         8762
       set     Origin      igp
-------------------------------------------------------
ospf
  1            Include
     match     Interface   vlan2
       set     Metric      234
-------------------------------------------------------
```

Table 2-10: Parameters in the output of the **show ip routemap** command

Parameter	Meaning
Map name	Name of the route map.
Entry	Entry number for the route map entry. Entry numbers can be any number, but all entries within a route map are sorted by entry number.
Action	Whether the action for this route map entry is include or exclude.
Clauses	The match and set clauses for this route map entry. Each entry can have only one match clause, and only one set clause of a given type. For information about the clauses, see the **add ip routemap** command on page 2-49.

Examples To display the IP route map with the name "import_static_map", use the command:

```
sh ip routem=import_static_map
```

Related Commands

add ip routemap
delete ip routemap
set ip routemap